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ABSTRACT

This project introduced microcomputers to small-scale construction trades programs through selected California community colleges. The computers were used for applications and computer-aided instruction in construction management and carpentry classes within the departments of vocational education. The project aimed to (1) define the uses for microcomputers in construction management and trades; (2) develop prototype applications and computer-aided instruction (CAI) software for use in the community college curricula; (3) develop training procedures for teachers and students; (4) evaluate the use of microcomputers; (5) refine and make available the applications and CAI software for other community colleges; and (6) involve the private sector in the problem analysis and project tasks. The project began with a survey mailed to the 42 California community colleges; of these only 9 responded, and only 2 were interested in participating in the study. The project, however, took place in three settings: a Merritt College introductory tools and techniques class; a Laney College wood technology class, and two two-week modules at the Santa Clara Carpenters Union Apprenticeship Training Center. Merritt College and the Santa Clara Apprenticeship Center both received remedial mathematics tutorial programs, while Laney College acquired a computer-aided design (CAD) program. The results of the project did not prove that the microcomputer was an effective mathematics tutor, and the CAD program was generally beyond the average students' capabilities. The computers, did, however, provide an acceptable classroom diversion and socialization factor. Recommendations were made for provision of training in microcomputers for teachers and sharing microcomputer software resources among community colleges. (KC)

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COMPUTERS IN THE SMALL SCALE CONSTRUCTION TRADES INDUSTRY APPLICATIONS AND EDUCATION

FINAL REPORT

Prepared for:

College Services Unit
Chancellor's Office
California Community Colleges

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September 30, 1984

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TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY

I. USING MICROCOMPUTERS IN COMMUNITY COLLEGE CONSTRUCTION EDUCATION: A DEMONSTRATION PROJECT 1

II. USING MICROCOMPUTERS IN THE VOCATIONAL EDUCATION CLASSROOM . . . 8

III. MICROCOMPUTERS USES IN CONSTRUCTION MANAGEMENT 13

IV. THE COMMUNITY COLLEGE CONSTRUCTION DEMONSTRATION PROJECTS

A. MERRITT COLLEGE 19
B. LANEY COLLEGE 29
C. THE SANTA CLARA CARPENTRY APPRENTICESHIP CENTER 34

V. FINDINGS AND RECOMMENDATIONS 41

APPENDICES

A. PROJECT SURVEY

B. DEMYSTIFYING THE MICROCOMPUTER

C. OVERVIEW OF THE INFORMATION DISSEMINATION WORKSHOPS

D. MICROCOMPUTER SOFTWARE RELEVANT TO THE CONSTRUCTION TRADES

EXECUTIVE SUMMARY

Introduction

This project introduced the microcomputer to the small-scale construction trades through selected California Community Colleges. The introduction of computers was in construction management and carpentry classes within the departments of vocational education. The uses of the microcomputer were applications and computer-aided instruction.

The organizational objectives for this project were:

- Define the uses for microcomputers in construction management and trades.
- Develop prototype applications and computer aided instruction (CAI) software to be tested and used in the community college curricula.
- Develop training procedures for teachers and students; select demonstration centers and train those teachers selected.
- Evaluate the use of the microcomputers using the quasi-experimental control group methodology.
- Refine and make available the applications and CAI software and documentation for other community colleges.
- Involve the private sector in the problem analysis and project tasks.

The major expected contributions are the students' familiarization with the strengths and weaknesses of the microcomputer as a tool, and the methodology and evaluation information to be disseminated to the other Community Colleges for use in their curriculum development.

Project Description

The project began with a survey mailed to the 42 California community colleges with relevant vocational education programs. Of these, nine responded. None indicated that they use microcomputers in the classroom, and only two indicated interest in participating in this study.

Almost four months were spent in the pursuit of hardware and software loans or donations to use in the demonstration classrooms. Eventually, three microcomputers were acquired: an Epson QX-10, a Commodore 64, and a Leo (an IBM PC compatible microcomputer).

The demonstration took place in three settings: a Merritt College introductory tools and techniques spring semester class, a Laney College wood technology summer session class, and two two-week modules at the Santa Clara Carpenters Union Apprenticeship Training Center.

The Merritt and Santa Clara Apprenticeship Center instructors both set remedial mathematics tutoring as their highest priority for the microcomputer. A construction math tutorial program was written for the Epson for Merritt, and the Fundamental of Mathematics software was donated for the Commodore for Santa Clara. The Laney instructor requested computer-aided design (CAD) as his priority use. A CAD program called CADDRAFT was acquired for the Leo.

Outcomes

The instructors and administrators involved in the project all agreed that microcomputers are becoming pervasive in the trade and the students' education must include at least an introduction to the use of these microcomputers. They also agreed that, for tutorial purposes, the microcomputer can be an effective tool in freeing the teacher of some redundant tasks.

The more sophisticated applications, including job costing, framing calculation, and CAD software, was generally beyond the average students' capabilities in the classes in this demonstration.

The test-control group evaluation at Merritt did not, however, prove that the microcomputer was an effective tutor in helping the students learn math. The project did provide some unexpected results in that the machine allowed for an effective and acceptable classroom diversion when needed, a perceived obstacle easily overcome for the insecure student, and other less describable socialization factors.

Recommendations

The current needs to maximize the utility of microcomputers in vocational education are:

- o to provide a minimum level of training to instructors to allow them to understand the potential uses for these machines in the classroom;
- o to create a mechanism through which resources for training and classroom use of hardware and software can be maximized; and,
- o to create an open channel between vocational education instructors to allow them knowledge of and access to these resources.

To meet those needs in a cost-effective and timely manner, we recommend the following steps be undertaken:

- o create a networking mechanism between all vocational education departments at the community colleges to allow sharing knowledge and resources;
- o compile all available resources; and
- o catalog and disseminate these resources as needed.

I. USING MICROCOMPUTERS IN COMMUNITY COLLEGE CONSTRUCTION EDUCATION: A DEMONSTRATION PROJECT

A. INTRODUCTION

In November, 1982 E.H. White and Company, a San Francisco based management and social research consulting firm, submitted an ambitious proposal to study the use of microcomputers in community college vocational education classes. The proposal was in response to an advertised procurement for a Vocational Education Special Project for the California Community Colleges, Office of the Chancellor. The area of construction management and technology education was selected for the demonstration because of the many practical and money saving applications of the microcomputer in the construction trades and because the industry is retively under-computerized.

The operational objectives for the project are to:

1. Determine the uses of microcomputers in construction management education and in the construction trades.
2. Develop prototype applications and computer aided instruction (CAI) software to be tested and used in the construction management community college curricula.
3. Develop training procedures for teachers and students; select a demonstration center and train those selected.
4. Evaluate the use of the microcomputers using the quasi-experimental control group methodology.
5. Refine and make available the applications and the CAI software and documentation for other community colleges.
6. Involve the private sector in the problem analysis and project tasks.

The proposed work program called for (a) creating a technical advisory committee to guide the project; (b) specifying the interest for microcomputer applications; (c) refining the possible microcomputer uses for the construction manager on the job; and (d) determining how these

applications can be taught by converting the major ones to interactive computer assisted instruction.

The contract called for introducing these applications into two community college construction education programs (construction technology and/or carpentry).

The project was delayed until September, 1983, largely because of the contract freeze imposed on all new State projects. Although the funds for the project came from the federal government, the contract had to be funded by a State agency and therefore had to wait for approval to proceed.

B. PROJECT FORMATION

In an initial organizing meeting with the Project Officer, Dr. William Boakes, it was concluded that all the community colleges listed as having construction management and/or carpentry programs should be surveyed to:

- Identify demonstration sites for the project;
- identify the range and type of use of microcomputers;
- identify the priority uses for software and hardware; and
- clarify issues about the use of micrcomputers as teaching aides in the classroom and as management aides in smaller scale construction.

Dr. Boakes urged the Project to involve a carpentry union apprenticeship program as one of the demonstration sites.

In the early months attention was divided between forming the technical advisory committee, identifying microcomputer uses in construction management and conducting the needs assessment survey for the project.

1. Survey Results

The survey (Appendix A) was mailed to 42 California community colleges. There were nine responses (21%) within the survey period. Of these responses, four (10%) said that they had discontinued their construction technology or carpentry programs. Five (11%) said that they had programs,

but only two, Merritt and Chabot, were interested in participating in the experiment.

None of the responding community colleges were using computers in their construction education programs and further, none expressed interest in knowing more about them. The two exceptions were the Carpenters 46 Northern County Apprenticeship Program in Pleasanton (which is sponsored by Chabot College) and Merritt College in Oakland. None of the some half dozen apprenticeship sites under the 46 county rubric was using computers in the classroom or had plans to do so. The Merritt program wished to use them but had no funds for their purchase.

In addition to coordinating the carpenters and millwrights apprenticeship program and curricula for the 46 county area, the Pleasanton center also hosts an apprenticeship training program. It is affiliated with Chabot College. The Director of Apprenticeship Programs readily agreed to participate in the program and after a meeting with the teaching staff and a project representative, it was felt that a stand-alone remedial math program was the priority use.

At Merritt College the carpentry program had been cut to just one class a semester. The spring semester class was a combination class and laboratory in construction tools and general techniques. There was a great deal of flexibility in the class format. Both the Supervisor, Robert Buckingham, and the Instructor, Hugh Stickney, felt that remedial math was the primary problem which should be addressed via microcomputer.

A third community college, San Francisco City College, indicated some interest in participating although they did not have a formal construction program in place. The initial interest came from an instructor, Mr. Gonzales, and then from Dean Bedacarrax. It was assumed that City College

would be the third test site. But for timing reasons and other pressures this did not occur.

Since neither the apprenticeship center or Merritt had computers or software, the better part of three and one/half months was spent begging for hardware and software. The hardware was of higher priority, since the operating system would determine which software could run on the computer.

2. The Project Advisory Committee

Thirteen persons were nominated by E.H. White & Co. project personnel to serve on the Technical Advisory Committee. Eleven members were selected. They met initially in November with 10 members attending. Based on their comments and suggestions, it was concluded to integrate the microcomputers (as yet none were available) into the classroom during the semester rather than at the beginning. It was clear, based on this meeting, that there was not yet a strong momentum for microcomputer uses in the construction industry and classroom. We were in the pioneering stages and had to learn the industry and educational requirements for ourselves.

Technical Advisory Committee Members are listed on the following page.

C. THE DEMONSTRATION EXPERIMENTS ARE HELD IN THREE SETTINGS

1. Merritt College

In March, 1984, an Epson QX-10 microcomputer was made available by the Epson regional sales office. Harold Charns, the E.H. White & Co. Project Director, wrote a construction related remedial math program for it in the BASIC language. After reviewing it with the instructor and training him in using the microcomputer, it was introduced into the classroom in March.

TECHNICAL ADVISORY COMMITTEE

Jorge Alfaro
Student
City College of San Francisco

Robert Buckingham
Department Head and Instructor
Vocational Education,
Merritt College, Oakland

Celia DeMartini
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DeMartini Brothers
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Chabot College
Pleasanton

Carolyn Taylor, Instructor
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San Francisco State University
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Ed Wicks
Contractor and Instructor
Sierra College
Rocklin

In the meantime a framing calculator and construction estimating software program was donated by Mendocino Software on diskettes compatible with the Epson microcomputer.

Other donated software includes a general purpose remedial math program (the Fundamentals of Mathematics) written for the Commodore 64 computer, Micromath for the Commodore PET, and two course authoring packages: CAIWARE-3D for the TRS-80 and Genesis for either of the Commodores.

It was decided that the computer should go first to Merritt since it is a fixed length program. The apprenticeship classes are organized in modules that met for one or two week intensive classes, according to where the apprentice stands in his or her apprenticeship.

2. Laney Community College

In the spring a third community college expressed interest in the demonstration program. An instructor in an advanced wood technology class at Laney College in Oakland requested that the Project assist him in introducing a computer assisted design (CAD) program into his summer class. After meetings with the Laney computer center coordinator and the instructor, project staff identified several CAD programs for possible use. However, their hardware requirements did not fit the range of machines available at the computer center. A microcomputer retail and repair store near the E.H. White & Co. offices, Mobile Computype, loaned an IBM look-alike, the Leo computer, with 384K random access memory and a color monitor to the project.

The Project Director researched the several CAD software packages, and selected and purchased the first generation version of a program called "P-CAD" for the project. This program is named "CADDRAFT", by Personal CAD

Systems, Inc. A "mouse" was also purchased to faciliate the on-screen design activities.

3. The Santa Clara Apprenticeship Training Center

In June, 1984 a Commodore microcomputer was donated to the project. However, by that time the Chabot College Apprenticeship Director was swamped with several new projects on top of the regular cycle of new classes each week, and therefore declined to participate. Acting on the recommendation of Charles Dorner, a senior official with the 46 county program, contact was made with the Santa Clara training site and the Commodore computer and remedial math software were introduced there. The Santa Clara carpentry apprenticeship facility uses a two week training cycle and the introduction of the Fundamentals of Math remedial program was less problematic. The instructor who was the primary user had prior experience with a Commodore 64 and was excited about introducing it.

C. CONCLUSION

The experiences with these three experiments, our findings about using microcomputers in the classroom, information developed on microcomputer uses in construction management, and our overall conclusions and recommendations form the basis for this final report.

We note in the final section that the project as conceived never quite "came to pass". Although they might disagree, the instructors who participated in this project reflect a change in the way these vocational skills will be transmitted. While they sense the change but cannot see it, these simple beginnings will mushroom into a broad use of computer and microprocessor technology in the classroom and the worksite.

II. USING MICROCOMPUTERS IN THE VOCATIONAL EDUCATION CLASSROOM

A. THE RANGE OF POSSIBLE USES

The E.H. White and Company survey results indicate that California is in the beginning stages of using microcomputers in community college construction education. They are not generally available; in a period of tight budgets they appear to be a luxury item. If a microcomputer becomes available, the individual initiative of the instructor determines if and how they will be used. However, their uses for remedial tutoring and to simply acquaint the student with them have been demonstrated.

Using the microcomputer as a tutor is very sensible. The programs are readily available or can be developed with an elementary understanding of the BASIC programming language. The comparative costs can be easily calculated by determing the number of hours that students use the microcomputer and software over three years and dividing that by the cost of the computer, software, maintenance and support. The costs, most likely, will turn out to be less than the instructor's hourly rate for the same amount of time spent in tutoring.

However, based on the results from the Merritt experiment, we must be very careful in making claims about the benefits in terms of increased comprehension when using the microcomputer as a tutoring device. The question becomes that of "given the resources, is the community college receiving a good return for the investment?" We feel that the answer in most cases will be a resounding "yes" if the computer can be used for other tasks in addition to tutoring.

The primary uses are:

- o computer aided instruction (CAI)
- o demonstrating construction management applications
- o class and departmental record keeping

Secondary uses include:

- o computer aid design (CAD)
- o simulating real world work assignments and problems

1. Computer Aided Instruction (CAI)

The several sophisicated CAI software programs that we are aware of cost more than $1000 for software which allows the instructor to develop his or her own teaching programs. Given the lack of resources and current interest, this initial cost plus the time involved in developing courseware is sufficient to discourage the development of creative courseware. Consequently, the use of computers to educate, drill and test students on aspects of carpentry and construction is not yet common and will not be soon unless software publishers offer flexible programs at a reasonable price.

2. Demonstrating Construction Management Applications

It is not difficult to demonstrate construction management applications using the microcomputer. This is most clearly the case in the areas of:

- o finance and accounting
- o bids and budgeting
- o project estimating
- o project scheduling
- o financial planning

However, these topics are not central to most community college offerings and in all probability would be used most appropriately in a survey course on contracting or on a specific course on construction management. Given the turnover rate of small contracting businesses, the added weight given to management seems worth consideration.

Software and/or packages for such a demonstration program can be developed within the California community college system and disseminated

to interested users if the networking mechanisms are available. It is easy to do and should remain simple in scope and content. In fact, a package that runs on a spreadsheet program can accomplish all of the above activities with relative ease.

3. Class and Departmental Record Keeping

The uses for the microcomputer in class and departmental management are so obvious that the instructors are usually allowed classroom access only if there is excess capacity after the administrators get ahold of them. Class rosters, schedules, student grades and records, budget tracking and inventory are among the many record keeping uses.

Developing and maintaining lecture notes using word processing software and disk memory is very useful for the creative instructor and allows him or her to easily update lectures and presentations. Likewise, having a copy of these notes in a departmental file may make it a bit easier for a substitute to step in and pick up the threads.

4. Computer Assisted Design (CAD)

A discussion of the Laney College computer assisted design demonstration is mentioned above and detailed in Section IV-B. Computer assisted design is very useful in several areas; most important among them are:

- o drafting and blue print design
- o house and furniture design
- o three dimensional visualization

The Laney instructor, Keith Nason, was particularly interested in the visualization uses of CAD systems. Being able to look at a design from all angles and perspectives is very helpful in determining the suitability and esthetics of a design.

With the continuing improvements in microcomputer graphics, the power of microCAD programs will increase. They are still relatively expensive, generally in the $1,000 to $3,000 range. So while they are nice learning tools, most construction and carpentry programs are better off taking advantage of CAD software available in other parts of the community college, at least for demonstration purposes.

5. Simulating Real World Work Assignments and Problems

Simulations are recreations of processes that are normally too expensive or complex to recreate in the classroom. Computers can be useful in simulating design, building, management and planning processes because they are interactive, have a memory, can manipulate data easily and can be readily changed. A recent generation of "think tank" and decision support software is available to be used in working through complex decision processes. Would such software be terribly useful in the demonstration programs we have worked with this past year? No, not really, but it will in the near future, especially if management becomes a more important aspect of vocational education.

B. CONCLUSION

The microcomputer will be an everyday tool for the majority of the population by the turn of the century. Therefore, it will be increasingly important that it be understood and used creatively in educational settings. When linked with video equipment and large scale information storage, the microcomputer will be an almost ideal teaching aid. For the moment, it has many uses to assist the instructor and to supplant him or her in performing redundant tasks like record-keeping and testing. It is highly improbable that the instructor will be replaced by teaching

machines. It is likely that the more mundane and routine tasks can be relegated partially to the microcomputer - to the benefit of student and instructor.

As has been demonstated in this project, we are in the very early stages of defining the uses that the microcomputer can and should play in community college vocational education (outside the electronics area). In Section V several steps are recommended to continue their use and build a responsible base of support for their use.

III. MICROCOMPUTER USES IN CONSTRUCTION MANAGEMENT

Since the microcomputer is invading the offices of many if not most construction organizations, and even some independent tradepersons, it is important for the vocational education administrators and instructors to understand the potential uses and misuses and purchase decision criteria of those microcomputers. Presented here is a brief discussion of these issues.

A. DO SMALL CONTRACTORS NEED A MICROCOMPUTER?

There are some compelling reasons for using a microcomputer in small scale construction management:

- o to gain a competitive edge
- o to reduce labor costs
- o to increase productivity
- o to improve information management
- o to increase profits through better cost accounting
- o to have rapid access to information
- o to improve planning and forecasting

However, the ultimate resource of the organization is its people. The human aspects of introducing the microcomputer require as much thought as the uses, software and hardware requirements. For most people it is strictly learning by doing and by word of mouth because this area of adult education and management training is just beginning to be addressed.

Before jumping on the microcomputer bandwagon, a contractor should first figure out whether a computer is really needed. An electronic calculator and typewriter may serve the needs of a small or fledgling organization. A business microcomputer with printer and a start-up set of software will cost at least several thousand dollars and take a minimum of two months to learn. During this time the business is strained by learning the computer and maintaining ongoing tasks.

Several computer professionals maintain that the computer does not save costs by replacing people. Its main advantage is allowing the user to keep track of things better and to obtain essential information more rapidly. This can provide efficiences and/or increase profitability.

Just like an employee, the computer should have a job description. What will it do? Where will it be placed? Who will be responsible for it? How will it communicate with the staff? What things will it do first?

The decision to add a computer should be tied in with some strategic planning about the nature and growth of the business of the next several years. This planning and the assumptions made about growth will help determine the type of microcomputer system to consider. It may be wise to pay a little more now in order to have a machine with expandable memory and a bit more power along with sufficient software. The need to get a machine that is or can be multi-user (several work stations on the same computer) may be an important part of overall planning.

Software can cost as much as the hardware. A complete integrated accounting package with a general ledger, accounts receiveable, accounts payable, payroll and inventory and/or job costing is often $1,500 or more. Before even thinking about what brand of software to buy, the potential buyer should write down the specific performance expected or wanted of the software and set up a budget for it. This is especially true in the case of accounting packages or modules.

Much of the management software can be distinguished by whether it is:

a. written as a computer program that will carry out a set of user instructions; or

b. written as a set of controls for a data base management system that is based on a set of data files that are addressed to obtain and use information within the files.

In the first case, it is very difficult and expensive to modify the system to fit the atypical needs of a user. It is likely that the source code (the actual program) will not be available. In the second case, the program can be modified, if the source code is available, but will probably require the aid of an experienced programmer. These considerations and their cost implications underscore the need to pay particular attention to planning software purchases.

The generic management support software like word processing, spread sheets and integrated management support software can be used with some training and preparation for a wide range of management activities including keeping books and producing payroll. These general applications require decisions regarding the particular uses to which they will be placed and develop the program to carry it out. In the case of spread sheets and integrated software, it is not necessary to be a programmer or have an active recall for algebra. However, it will require some time to master the application.

Accounting packages and other specific applications packages are almost always "menu driven", which means that the user has a menu of choices and a directory of help commands to guide her or him through the steps. Well designed programs that have been in the market place for awhile can be mastered within several weeks to a month's time to the point where they can be actively introduced into the management process. However, once one person has learned the software, it is wise to have a second person oriented and acquainted with it; the primary user may get sick, be away from work for some time, or leave the organization.

For first time users, allow plenty of time to become acquainted with the computer, its operating system, and the way software works before

carrying out a major step like automating all or part of the accounting. Basic rules like always backing up the files to a separate disk are almost always learned by losing some information and having to reenter it into the computer. In addition, the introduction of the microcomputer changes how information is stored and managed and this takes time to adjust to and implement.

B. MANAGEMENT RESPONSIBILITIES AND MICROCOMPUTER SOFTWARE

Figure 1 is a list of basic management responsibilities common to construction and most other organizations and the common management software which is available. An "x" is placed to identify the software application likely to fit the management function.

C. PURCHASING DECISIONS

How can a potential buyer be reasonably certain that the computer will meet the organization's requirements? One way is to consider these recommendations:

1. Choose the programs first. Look carefully at how the organization works, document requirements, and see how closely the basic programs come to meeting needs. Insist on demonstrations of the software and use transactions from the organization's files to test how the program functions.

2. Assure support. Be confident that the vendor can provide follow-up training and technical assistance. Consider the vendor's likelihood to remain in business. We prefer vendors who have been around for at least five years.

3. Choose hardware last. The hardware must be compatible with the programs required. It must be large enough to handle the software and data storage requirements, and fast enough to handle a busy day's work with ease. Be liberal in estimating data storage and memory requirements.

Figurel: Software Applications for Construction Management Responsibilities

Function	Software Application wp	ss	as	dbms	jc	ic	ps	es	c
1. Administration									
strategic planning	x	x	x	x	x	x	x	x	x
legal and tax compliance		x	x	x		x			
performance standards		x	x	x	x	x	x	x	
facility operations and maintenance	x	x	x	x		x			x
2. Finance									
fiscal planning		x	x	x	x	x	x	x	
budget development	x	x	x	x	x	x	x	x	
cost control		x	x	x	x	x	x	x	x
audit		x	x		x	x			
investments		x	x	x					x
benefits		x	x	x					
insurance and bonding			x	x	x			x	
3. Personnel									
recruitment	x						x	x	
staff development				x			x		
benefits program			x	x					
job descriptions	x			x			x		
personnel evaluation	x	x		x	x		x		
personnel policies	x								
4. Project Development									
scheduling	x	x			x	x	x	x	
cost accounting/containment		x	x		x	x	x	x	
inventory control		x			x	x		x	
project management		x	x	x	x	x	x	x	x
5. Marketing, Public and Community Relations									
publicity	x	x	x		x				
information dissemination	x	x	x		x		x		
advertising	x	x	x		x		x		

Key
wp = word processing
ss = spread sheet
as = accounting system
dbms = data base management system
jc = job costing
ic = inventory control
ps = project scheduling
es = estimating system
c = communications

4. Purchase a total system if possible. Acquiring an integrated set of programs, support, and hardware reduces the risk of failure and start-up delays. Be sure to find out about maintenance services for your hardware; often maintenance contracts are too expensive, considered them carefully. It is the peripherials that will be most likely to need maintenance after the warrantee period. Any problems with the computer will surface fairly soon after purchase.

A 1982 study reported that companies surveyed with revenues less that one million per year spent 24.2% of their revenues on all data processing and related costs (including personnel), while companies with revenues from one to five million spent 10%.

A fully equipped single-user microcomputer will generally cost from $3,000 to $7,000. Software may add $300 to $1,000 per package or module. A multi-user system with hard disk drive, terminals, and printer will cost upwards of $10,000 not counting the software.

Because of these costs, some companies are carefully considering buying used computers, especially from persons who are computer literate and knowledgeable about their machines. The most likely problems will be with the disk drives and printers, and higher maintenance costs are to be expected.

IV. THE COMMUNITY COLLEGE CONSTRUCTION EDUCATION DEMONSTRATION PROJECTS

A. MERRITT COLLEGE CONSTRUCTION TOOLS CLASS

1. The Setting

The Merritt College demonstration was held in the Construction Tools and Techniques Class and Laboratory (course number 0230) under the direction of the class instructor, Hugh Stickney. Mr. Stickney is presently working on a master's degree in educational technology and was very interested in participating in the demonstration. He "job shares" the class with a colleague, and consequently the computer was available once a week during the 5 hour lab session. His supervisor, Mr. Robert Buckingham, was also an active supporter of the demonstration and serves on the Project Advisory Committee. It was Mr. Buckingham's initial interest and enthusiasm that led to Merritt's participation.

2. The Priorities

In the initial meetings with the two men it was determined that the greatest classroom problem in which a microcomputer could be of service was remedial math. There was a wide range of math competence in the class and a continuing need to be able to make rapid calculations and conversions while building the model house and doing small woodworking projects. Further, the need to perform on-the-job calculations is a fundamental knowledge requirement for any skilled carpenter.

Other priorities included:

- o construction techniques tutorials (e.g., roof rafter design), and
- o job costing (including materials and labor costs).

The major planning problem was getting a microcomputer; it is difficult to design and/or solicit software without knowing on which system it

is to be used. Although there are several DEC VT-180's at Merritt for the electronics classes, they could not be made available for other vocati[illegible] education classes. And, while three different microcomputers were [illegible] to the demonstration in January, the first, an Epson QX-10, was not received until the end of March.

Because no appropriate software had been obtained which could be run on the QX-10, a remedial math program written in MBASIC was prepared by the E.H. White and Company Project Director, Harold Charns. It was based on the specifications and teaching style of Mr. Stickney, and modified slightly in a meeting with him. The menu driven program provides the user three choices:

1. Converting fractions to decimals
2. Converting decimals to fractions
3. Calculating areas and volumes - linear feet, board feet, square feet and cubic yards

Each user "signs in" by his or her name (usually just the first) and the program responds to answers with a variety of "that's right, (name)" and "that's wrong, (name)" quips. A record of correct and total exercises is stored according to the sign-on name.

The three learning modules include a tutorial that visually describes the calculation process through examples. The user can skip the tutorial or rerun it. The two conversion programs then go on to present some calculation examples with the user being asked at the end of each whether to continue with another example or move on to the exercises.

As noted, the user scores are kept in a special file that is only accessible to the instructor, using the sign-on "TEACHER". This allowed him to check on progress as the semester moved along.

Shortly after the demonstration began, a framing calculating and estimating program was made available by a software vendor, the Mendocino Software Company of Willits, California. This was in keeping with the original priorities. Some interested members of the control group were able to use it and to get a sense of its properties. However, Mr. Stickney concluded that the estimating program was too sophisicated for all but a few in the class; it was, therefore, essentially set aside.

3. The Demonstration

It is important to understand that this demonstration was brought into a class on construction tools. While the instructor had flexibility in the conduct of the class, especially the lab portion, the microcomputer could not be a central fixture in the teaching. This was true for two reasons:

1. Because the type of microcomputer was unknown almost until it was delivered, it was not possible to write software in advance or attempt to solicit donated software because the operating system and system size were unknowns.

2. The instructor, while learning BASIC programming, did not have the opportunity or time to develop his own courseware. In fact, it would have been somewhat difficult to develop tailor made courseware for such a lab. (He has subsequently been working on an Apple II version of a remedial math program to include color graphics and a more appealing format.)

The alphabetized class roster was divided in half, with every other student (15) assigned to the computer user (test) group. The instructor made certain that every student assigned to the test group used the tutorial. He was very insistent that low achievers used it consistently, usually once a week, during the course of the three month demonstration.

It was decided that the computer could stand alone in a storage area next to the workshop and students could use it to practice their basic math computations. A dust cover was built to cover the central processing unit and disk drives because of the amount of sawdust in the workshop's air.

Students spent from 15 to 45 minutes going through the three tutorial modules. The students were expected to use a hand calculator to work out the problems and to answer a minimum of 10 questions in each of the three computational sections. Mr. Stickney had covered these basic computational methods in his classroom presentation prior to the demonstration.

The class was observed four times over the course of the demonstration. Informal conversations were held with members of the test and control groups. Formal interviews were held toward the end of the demonstration with six or the 15 members of the test group (not all students remained until the end of the semester).

At first, almost everyone seemed interested in the computer and the tutorial program. According to Mr. Stickney, there was some grumbling about not being able to be in the test group, but it soon abated when the limits of the applications were explained.

As is the case with most applications for CP/M operating systems, the tutorial program was direct and unadorned with graphics. Toward the end of the demonstration, Mr. Stickney noted that it would be nice to have some kind of reward for completing the tutorial or doing well on a given day. There was talk of adding a video game to the disk, with time to play allocated according to number of exercises attempted; however, this did not occur due to time constraints. The interest in the computer was definitely falling off by the last weeks of the demonstration. This was apparently because the program is:

(1) fairly limited and the repetitions were becoming tedious, and

(2) it was more appealing to work on the model house.

4. Outcomes

Only one interviewed test group member did not think the tutorial was helpful. She is an older woman who felt she had a very good command of construction math and had prior experience with computers. The remaining interviewees felt that the tutorial was helpful in:

- o understanding on-the-job math
- o learning to use calculators
- o speeding reasoning
- o increasing comfort with basic math problems

Another perceptual outcome, not stated by the students but noticed by the instructor and the evaluator, was a marked increase in motivation and improvement in attitude toward learning the subject matter, and in fact learning in general. Two case situations illustrate this point:

- o Joe came into the class with a very bad attitude about authority figures, especially teachers. He was antisocial - a tough guy who knew everything he needed to know already. The computer, however, represented a learning system in which he was the master, and although he left class before the end of the semester, he left with an excitement about learning.

- o Belle is an older woman who was in school for the first time since high school. Her self-confidence was low, and she felt she had lost the ability to learn (though her test scores indicate the opposite). The computer, with its immediate feedback and simplistic but in this case effective positive reinforcement, helped her realize that she was still able to learn.

There were two other students in the test group who had learning related problems. One student has a visual problem and a serious attitudinal problem, while the other student was a very slow learner/reader with an obvious learning disability. While the former complained that he did not like computers, after several false starts seemed to take easily to it, and when subsequently observed, did well on his practice drills. The slow learner was not intimidated by the machine (in fact started to ask the observer fairly technical questions about it toward the end of the demonstration), however, it took him a very long time to read the questions and

work out the answers.

It is especially interesting that respondents saw the computer as a way of teaching the use of the calculator. Two of the students interviewed had never used calculators, and several others had only minimal exposure.

Mr. Stickney made sure the people with the more evident math deficiencies used the remedial program regularly. The machine was accepted readily. After the initial interest, the computer became essentially another tool. None of the test group who were observed at the computer objected to being observed while doing the math drills.

To explain to the students how to use the math tutorial program, Mr. Stickney developed a video tape as part of his master's classwork. With the exception of his very active interest, intellectual participation and collaboration, there seemed to be little other instructor interest in learning about the demonstration. This can be partially explained by the fact that the construction education program has been gutted by budget cuts. Mr. Buckingham was very supportive of the project in general and participated in setting the priorities, but was also very busy with other matters.

5. Impact Evaluation of the Computer-Based Math Tutorial

The basis for assessing the impact of the microcomputer in the classroom in general, and the computer-based math tutorial in particular, is (1) the comparison of pre-test and post-test scores of the test and control groups, and (2) the observations of the instructor and the evaluator. As noted, the groups were selected randomly by assigning every other student on the class roster to either a test or control group.

While there were about 15 students in each group, not all of them were present for the pre-test in March and the post-test in late June. Table 1 displays a comparison of the test and control group scores for both tests where the students took both tests. Based on this comparison, it appears that the control group showed a greater improvement than the test group when comparing the improvements from the pre-test to the post-test. In fact, the control group (with one exception) and the test group (with the exception of three high achievers who did very well in both tests), shows an extraordinary improvement in test scores.

TABLE 1: COMPARISON OF TEST AND CONTROL GROUP SCORES

	PERCENT CORRECT		
PARTICIPANT	PRE-TEST	POST-TEST	DIFFERENCE
TEST GROUP			
Raymond	96	96	0
Hong	96	96	0
Belle	92	92	0
Rich	6	48	42
Jim	0	16	16
Kevin	12	40	28
Lum	48	80	32
GROUP AVERAGE	50	67	17
CONTROL GROUP			
Doug	4	76	72
David	16	60	44
Vanneoun	4	56	52
Steve	88	72	-16
Becky	0	48	48
GROUP AVERAGE	22	62	40
CLASS AVERAGE	39	65	27

Based on these results, it appears that the introduction of the micro-computer based math tutorial did not have a significant impact on the test

group participants as compared with a control group. Given the sample size and length of the demonstration (about three months), it is difficult to attribute much significance to these findings. However, they can be instructive in that they indicate that the intervention of the math tutorial did not seem to produce significant impacts in the very short run.

The two conversion programs (inches to feet and feet to inches) were those assigned by Mr. Stickney for the test students. The volume calculation program (linear feet, board feet, square feet and cubic yards) was available for the students to learn from and use; however, it did not have an exercise with feedback module, and was thus not specifically assigned.

TABLE 2: TEST GROUP TUTORIAL PROGRAM EXERCISE SCORES

NAME	FRACTION-DECIMAL	DECIMAL-FRACTION
Ant S.	81/ 90 = 90%	82/104 = 79%
Belle	24/ 29 = 83%	36/ 52 = 69%
Betty	18/ 25 = 72%	13/ 14 = 93%
Cal	2/ 4 = 50%	0/ 0 = 0%
Calvin	9/ 10 = 90%	8/ 10 = 80%
Daryl	6/ 6 = 100%	0/ 0 = 0%
Focha	15/ 20 = 75%	17/ 20 = 85%
Hong	4/ 4 = 100%	2/ 2 = 100%
Jim	62/ 68 = 91%	86/114 = 75%
Kevin	21/ 23 = 91%	27/ 32 = 84%
Lum	11/ 11 = 100%	9/ 10 = 90%
Morgan	11/ 16 = 69%	20/ 22 = 91%
Raymond	29/ 32 = 91%	27/ 27 = 100%
Rich	41/ 47 = 87%	46/ 53 = 87%
Wilson	21/ 21 = 100%	48/ 50 = 96%

The exercise scores for these programs indicate that most of the test group were able to solve the problems. However, the slower students often had a peer sitting with them for a portion of the practice session, and in almost all cases they used a hand calculator to solve the problems. Table 2 displays the test group practice scores. They indicate very little in themselves, other than identifying those students who were assigned to the

computer for substantial practice. They do indicate that the math tutorial was used regularly.

6. Conclusion

The Merritt setting offered a diverse class common to many community college vocational programs. There were students coming directly from high school who were not sure what they were going to do with their lives, and who have a varying set of skills, knowledge and interest in the program. There were also older students interested in learning new skills and possibly a new craft. According to Mr. Stickney, this diversity was very evident in their math and computational abilities.

The most serious problem of the slower, more poorly educated and/or less motivated student is understanding construction related math. Math is used in every facit of building; one who cannot make simple calculations and computations is ill suited for carpentry as a job or as a hobby. The role of the microcomputer was to help with these math deficiencies. A program was written, therefore, to instruct and to drill the test group in basic construction computations.

Since the test group was selected randomly, the more accomplished students only had to use the program minimally, while those with greater math deficiencies used the program till the end of the semester. Within the test group, the duration of microcomputer use was predicated on need. The microcomputer and software became a tutor and the effort was viewed as a tutorial activity for the underachievers.

Thanks to the active and eager participation of the instructor, Hugh Stickney, the microcomputer was introduced into the lab with little fanfare and minimal problems. There was almost no resistence to using it, and it soon became another lab tool. Although it addressed several priorities

(building materials estimating and person time estimating), the framing calculator and building estimator programs donated by Mendocino Software was too advanced for the class and was probably inappropriate for the particular class, and therefore was never integrated into the lab.

The math tutorial intervention did not have a measurable impact. The control group actually performed better when comparing pre-test and post-test scores. While the demonstration was carried out in a very applied setting over a very short period of time, care was taken to remove bias from the demonstration. The size of the test and control groups who participated in the pre-testing and post-testing was very small and the results are not truly significant. Still, it does appear that the microcomputer based math tutorial in the very short run did not have a measurable impact.

There was an impact of the microcomputer as an additional teaching tool available to students with attitude and/or learning problems. Possibly because of its newness and mystique, its ability to remove the student from the peer pressures of the classroom, or its relative submissiveness to the student, the microcomputer allowed some of the problems that block the learning process to be removed or at least diminished.

The objectives for demonstration site have been met: to place a microcomputer and appropriate software in a construction technology classroom, to measure and observe its effect on the learning process, and to evaluate qualitatively and quantitatively the impacts on the students.

B. THE LANEY COLLEGE WOOD TECHNOLOGY CLASS

1. The Setting

When City College of San Francisco was removed from the demonstration project due to schedule conflicts, the E.H. White and Company Project Director had to find another demonstration site. A meeting was scheduled with the Assistant Dean of Applied Technology, Mr. Marcus Conteras, at Laney College in Oakland to explain the project. When Mr. Conteras was convinced that this project would not cost the College anything or interfere with the normal course of instruction except in a positive manner, he agreed to participate.

2. The Priorities

Mr. Keith Nason, a carpentry instructor who was to teach a summer workshop in wood technology indicated that he would be interested in using a microcomputer and computer assisted design (CAD) software to help teach project design and visualization. The computer center coordinator was very helpful and ready to cooperate. The computer center had a number of Apple IIe computers with color monitors that could be available. However, their expansion slots were being used and the memory could not be upgraded. A search began to find CAD software that ran on the computer center equipment.

Based on Mr. Nason's prior research, he preferred two software packages. None ran on the available hardware, and one was very expensive. The second one, P-CAD, and another examined by the Project Director and Senior Researcher, Micro-CAD, run on an IBM PC or compatible microcomputer but require additional random access memory (RAM) and a color monitor.

3. The Demonstration

A retail computer store near the E.H. White and Company offices, Mobile Computype, voluntered to loan the project an IBM look-alike called a "Leo". Mr. Nasan, given the choice, preferred the P-CAD software; the cost of $1,300 was too high so an earlier version called CADDRAFT, with less capacity but virtually the same application options, was purchased. After several weeks of waiting for a memory board and color monitor, the experiment was ready to begin.

Mr. Nason was familar with computers although he had never really used them. One of his teen age sons was learning PASCAL and Mr. Nason was confident that he could learn the software rapidly. This proved to be the case. He was given a demonstration of the hardware and software and a basic set of instructions about the hardware and operating system and left on his own pending any problems.

The Laney test site was visited twice during the month to observe the microcomputer in use. Unlike the Merritt class and the Santa Clara Apprenticeship program, this course was comprised primarily of "hobbyists" who were enrolled to use the shop equipment to work on individually initiated projects. The class consisted of a wide range of students from young college age students to retired people. The ethnic make up of the group was as diverse as their ages.

The Instructor gave a one hour demonstration of the microcomputer and CAD software to the students, and offered to give additional instruction to any students who might be interested. Basically only two students used it (15% of the class): one female student who saw the computer as a means of making her more marketable within the trade, and one student who actually works with a CAD system in his daily employment. The other students wished

to maximize their time with the tools.

Being somewhat familiar with computers, Mr. Nasan recognizes their value in the carpentry and construction industries. He also enjoyed using it. He noted that the CADDRAFT program was relatively primitive in terms of what more sophisticated programs are capable of running. However, Mr. Nasan thought the CADDRAFT program was too advanced for his students; to fully utilize the computer program the students should have a pre-requisite course in drafting. He did think, however, that some students have problems visualizing a project and in these cases the students might be assisted by using the computer. He noted in passing that if he were to use the computer more extensively he thought a math program would help some of the students in estimating cutting and costing individual projects.

Mr. Nasan foresees the use of computers in the colleges and trades as being the "wave of the future" and as such he personally plans on pursuing his knowledge so he can utilize the available software programs.

4. Outcomes

During the course of the site visit several students were interviewed. Of most interest was a young woman who was the principal user of the computer. Cory is in the process of trying to break into the trade and noted that it was especially difficult for a woman because of physical stature and general prejudice. Because of this she viewed the knowledge and experience of use of the computer as a marketing asset to offset this handicap. During the last week she was, in fact, offered a position, she stated, primarily because of her familiarity with the computer.

Since the availability of the computer was so instrumental in her case, we spoke with her at some length. She stated that she had some familiarity with computers, but until this class she was not aware that CAD

software programs existed. Although she did not use the program on her current project, she stated she would use it on her next project from beginning to end.

She stated that she thought a one credit computer course should be linked, in some manner, to the vocational education classes so that by the time the students were confronted with the computer in those courses they would be ready to use them.

It was evident that this was a very motivated young woman who had obviously given a great deal of thought to her chosen field and her strengths and weaknesses for work in that trade. Because the computer was available she was able to increase her marketability, and to overcome a perceived physical liability for herself in that trade.

Several other students were interviewed who did not use the computer, one of which was a retired cabinet maker. It was clear from the outset of the conversation that although the gentleman thought the computer was wonderful and had great potential, it was "past his generation." This will be typical of older students taking vocational courses. The willingness of young people to use the computer has been facilitated by the current generation's knowledge of computers, their greater "computer literacy."

5. Conclusion

In this experiment the software was meant to assist the student in performing a work related task faster or with more flexibility. Many of the class had a clear idea of what they wanted to do, had their plans already in hand when the class began, and needed the class for the tools and shop space and occasional technical assistance. They did not need much supervision or diversion. Consequently, many were not interested in using

this particular software application - it was of abstract interest only.

As concerns the instructor, we conclude that the willingness to use the computer fits the pattern observed at the other test sites. The willingness to use the machine and resident software is a self selective screening process. Those instructors who have some knowledge of computers are those excited about the possibilities that this added dimension can bring to their courses, and are aware of the impact they are going to have in their trades. Conversely, and as is the case within the general public, those instructors not familiar with computers feel threatened by their use, and by their introduction within the trades.

This experiment was not evaluated using control and test groups; it was not possible or relevant. The trade-off was that the project had the opportunity to observe one of the most sophisicated software applications appropriate for this project in a classroom setting. As in the case with the Estimator and Framing Calculator software available to the class at Merritt, it was too advanced for the situation, but served as a good frame of reference for the instructor in continuing his interest in software applications and an interesting introduction to the power of the microcomputer for the students. With the exception of the quasi-experimental control group evaluation, the project objectives were met with this test site.

C. THE SANTA CLARA CARPENTERS APPRENTICESHIP PROGRAM

1. The Setting and The Priorities

Most of the background for this project is presented in Section I. However, it is important to note that among the training centers run by the 46 Northern Counties Carpenter's Apprenticeship Program, Santa Clara enjoys a reputation of being among the best, if not the best.

When the Program in Pleasanton was unable to participate because of a work overload, we were advised to talk with Mr. Bob Rath who directs the Santa Clara center. Mr. Rath noted that remedial math was a major concern with their apprentices and told us to contact him when we had a computer to demonstrate some possibilities. The project decided to use the Commodore microcomputer and the Fundamentals of Math software programs rather than the CP/M based construction math program because of the greater breadth of the software.

The carpenters' apprenticeship program cannot reject any entry level apprentice who has a high school diploma. Because of this the program accepts many students who have minimal mathematical skills. Upon entry to the program each apprentice must take a math skills test; those who have a very low score are strongly advised to go to a Learning Assistance Center (LAC) at San Jose City College. Program officials cannot formally require that they attend. Apprentices, however, are warned that if their math skills do not improve, they will have to repeat a particular learning module until they do improve.

Mr. Rath noted that because attendence was not mandatory at the LAC, apprentices have little initiative or incentive to attend. Consequently he is hoping to bring the LAC program to the Santa Clara Center and run it themselves. As a learning tool he plans to incorporate an audio-visual

tutoring program for the students, and sees the micro-computer as an adjunct learning tool to that system. Because this is in the planning stage, Mr. Rath could not be more specific as to exactly how he might incorporate it within the learning assistance module.

The math testing occurs in the first two week module, a general purpose orientation and work safety training. This would be the ideal place to begin the math tutorial. The apprentices could then become familiar with the computer at the beginning and the available software throughout their four year apprenticeship training.

2. The Demonstration

The programs and the Commodore 64 were demonstrated to Mr. Rath and the Program Coordinator, Roger Trombley, in early July. They were interested in testing the programs and asked to use them for the rest of the demonstration period. The Center was visited three times during the experiment. The classes turnover every two weeks.

At the first site visit, Mr. Rath said that he was very pleased with the Commadore and thought the computer would be a valuable tool for the students. He reiterated that the students' problems, and therefore the added value the computer could provide, were their remedial mathematics needs.

Mr. Trombley placed a notice on the outside door to the office about the "Computer-Tutor" and asked any interested persons to see him. However, almost all of the computer users came from one instructor's classes.

One of the three instructors at the Training Center chose to use the microcomputer as part of the course. This instructor, Mr. William Johnson, was very pleased with it. Generally, instructors seem to demonstrate a

degree of "computer intimidation" like that found in the general public. Staff perceiving that they know more than any computer could know about the particular aspect of the construction trade they are teaching are far less willing to consider using the microcomputer. As might be expected Mr. Rath, Mr. Trombley and Mr. Johnson, are somewhat familar with microcomputers. The Center uses an IBM-PC with a hard disk to schedule and track apprentices through the program. Staff can use word processing and a spreadsheet program for administrative purposes. Mr. Trombley keeps the materials inventory on a spreadsheet program. Mr. Johnson has a structural engineering background, owns a microcomputer and has done a little programming.

In each two week training cycle the instructor teaches a different module. During the initial observation, the class was blue print reading, a fairly advanced module. Therefore, because of the class content and the fact that it is for the advanced apprentice, it is reasonable to expect more interest in the microcomputer. (The highest attrition rate is between the first and second year of the carpenter's apprenticeship, according to Mr. Rath.)

Mr. Johnson's approach is to give the apprentices a brief introduction to the machine, demonstrate its use, and explain the type of work problems in the software program relevant to the particular module. He stated that the students were enthusiastic, and during the first two weeks of its avilability almost 80% of the students had made at least some use of it.

Mr. Johnson noted that the greatest asset of the computer was that it could be used right there, and that the apprentices perceived it as being a great alternative to going to the LAC. After a long day in the classroom (two weeks straight, eight hours a day), the students were likely to leave

class, after a long day, and go home rather than drive to San Jose, fight traffic, and find a parking space at San Jose City College.

During the microcomputer's initial use, Mr. Johnson noted that the students who really didn't need it were the ones most often seen on the computer. He felt, however, that this would be overcome with time, i.e. getting used to it and seeing peers using it.

In the initial visit the project staff spoke with four Center staff. All agreed that the two main uses to which they would like to see a microcomputer put are math and English comprehension. They noted that the range of students' capabilities in both ran the gamut from little knowledge to an acceptable level. They also noted, however, that some of the problems with the microcomputer math program that may arise, due to the fact that some students basically cannot read, thus written instructions in almost any form can prove difficult for the student.

It appeared that the line staff other than Mr. Johnson had less idea of the capabilities which the computer could add to their specific courses. When the characteristics and potential uses of the CAD software were explained to two staff, they immediately became enthused and talked of visiting the Laney campus to view the microcomputer demonstation there.

During the second visit the class was made up of first year apprentices taking an introductory module in concrete floors and foundations. In this case there was less interest and less use of the computer. Several of the apprentices were recent immigrants from southeast Asia who had come from a Job Corps preparatory program in Sacramento. Mr. Johnson observed that the immigrants were attracted to the computer because the mathematical symbols were easier to comprehend than the classroom English.

Although notices were placed around the training facility, alerting all students of the computer's availability, only those from Mr. Johnson's classes used it. It is most likely because of the rather intense nature of the two week sessions and the newness of the machine to the Center.

During the blueprint reading course, a program survey questionnaire was administered to Mr. Johnson's fifteen students. Seven of the 15 survey documents contained unsolicited statements under the "Comments" section; they are reporduced here as follows:

- I thought that the computer that they let us use was a great help with my mathematics. They should get more of them.
- I think having the Commodore computer is a really good idea. I only used it for about 1 hour but if I had more time I would of used it.
- ...more time to use the computer.
- ...very instructive! Also computer was very helpful.
- The computer wood (sic) have ben (sic) more help if I could have had more time to use it.
- The computer helped in reviewing my math skills and to learn some new ones.
- The use of the computer was very helpful, not only in the math but also in the actual operation of the computer itself.

In addition, an unsolicited letter to the staff stated:

> "I thought your computor (sic) was really helpful in math. I learned alot about formulas. I think you should have all your instructors tell the students about it. It really does help."

In this initial group, the apprentices seemed very interested in the computer per se, asking questions about cost and capability beyond the program used in the classroom. Generally, as noted above, four or five of the 15 students made the most use of the computer in terms of time spent on the machine.

The general comments by the apprentices revolved around the theme that while it helped them in their basic math, the programs were limited. Our observation is that they became very interested in the computer itself, but only a few really utilized it to the extent the program allowed. In one case the individual stated that he thought the program was too redundant; i.e., when you had successfully completed a basic problem in one segment, the program made you do so many more, of the same concept, that it became boring.

In discussing the microcomputer with the concrete flooring and foundations class, it was clear that the apprentices were not interested or ready to use the microcomputer. Several apprentices expressed an interest in using it and one had prior experience with them. However, because they were so new to the program, and adjusting to a school type environment again, the computer as a tutorial resource was of little interest.

3. The Conclusions

Our general observation was that the computer gave the students an added diversion, a diversion however which was used to fullfil a very basic need, i.e. practice on their basic math.

The Program Administrator, Program Coordinator and Instructor have been very enthusiastic about the use of a microcomputer in the Program. This must be tempered, however, with the caveat that they are somewhat familiar with microcomputers and their capabilities.

After further discussion with other staff, they became more enthused about possible uses as they began to relate the microcomputer's possibilities to their individual courses.

The staff concluded that the most basic needs of the students was first basic mathmatics, and then reading and writing. Mr. Trombley calls the micro the "quiet tutor" and would like to have two in each classroom for tutorial purposes. Since the very heavy emphasis in the apprenticeship training is hands on, there is not a wide range of classroom uses for the micro other than tutoring. However, the senior staff would like to add a post apprenticeship refresher and continuing training program added to the center's activities at some point and can see how a microcomputer could be used in construction planning and management classes.

Generally, Mr. Trombley and Mr. Johnson were satisfied with the Fundamentals of Math software. Ideally, they would have liked to have more advanced math also, though it would not have been as necessary since the tutorial was aimed more at the underachievers.

Mr. Trombley observed that the students have been very cautious and careful with the hardware and software. He noted that this was unusual and added that he was confident that a free standing computor tutorial could be easily implemented, given administrative support and sufficient budget. He seems to feel that the "quiet tutor" will be used in their classrooms in the near future.

V. FINDINGS AND RECOMMENDATIONS

A. PROJECT OBJECTIVES

The project as originally conceived never quite came to pass, as is often the case with demonstration projects. The proposal authors had assumed more community college interest and more current involvement in microcomputer use, a higher level of software sophistication than the students could use, and more interest on the part of hardware manufacturers and software authors in advertising their wares through a loan or donation. The project began and spent much time with the begging and borrowing of hardware and software; the time that was to be spent in creating original software was instead spent hustling hardware and software to facilitate the project.

In fact the students were not ready to learn or even consider the ways microcomputers could assist them in the world of work. The instructors had more pressing problems: assisting students who needed to learn or relearn work related math. In this process of using the micro as a math tutor, several students, at least in Santa Clara, concluded that their reading skills were deficient. They were advised to utilize a nearby learning center.

All of the project's objectives were met, though not to the degree initially assumed. In light of this fact, we make a set of recommendations that, if implemented, can expand the interest and knowledge base necessary for community college vocational education to more effectively utilize microcomputer technology. These recommendations are process in nature and relatively inexpensive to implement, although they do involve significant coordination and communication.

B. PROJECT FINDINGS

As noted in Section I, the E.H. White and Company survey of community college construction education programs found that none of the respondents were currently using microcomputers in their classes. While this is probably not surprising, the researchers were taken aback by the apparent lack of interest in using them. One of the indicators of this lack of interest was the low rate of response to the survey at the start of the project. The most likely explanation is that the carpentry and construction vocational education programs have been seriously curtailed by recent funding cutbacks and these programs are operating in a "survival mode" unless and until the budget picture improves.

However, our literature search via ERIC yielded only one citation regarding microcomputers and vocational education. Based on our survey results, this literature search, and conversations with instructors, we conclude that the community colleges are in the very early stages of using the microcomputer in vocational education classrooms with the notable exception of electronics. If this is accurate, it poses very interesting strategic questions for the California community colleges in addressing the classroom uses for this increasingly pervasive technology.

Based on our experiences with the two community colleges and one carpentry apprenticeship program in this project, we have reached these conclusions about introducing microcomputers into construction education programs:

1. Instructors and administrators did agree, in general, that the computer aspects of the construction trades will become increasingly important to any individual within the trades.

2. Based on survey results, it appears that some vocational education instructors reflect the same computer intimidation as found in the general population.

3. For basic courses, all instructors agree that basic math programs, dealing with those functions specifically necessary for individual trades, is a necessity.

4. Beyond math, instructors note that basic reading problems exist for many of their students (something clearly beyond the scope of this demonstration project or the vocational education class).

5. Based on the Merritt experiment results, it appears that using the microcomputer as a remedial tutor does not significantly improve student scores in the very short run when compared with a control group. This experiment should be repeated in similar settings over a longer period of time along with other measures of utility.

6. Both students and staff at the Merritt and Santa Clara test sites attested to the benefits as a microcomputer as tutor for remedial math or basic subject matter.

7. Students, who are generally younger and who have been "computer socialized" are generally willing to consider the use of the computer. We did not encounter any computer anxiety among the students and only one set of symptoms among the staff and managers.

8. In the three different cases where the microcomputers were used, the instructors picked up on their use immediately. In two of the three cases the instructors had been using microcomputers recently while in the third case the instructor's son was involved in programming. Still, the adaptation to the equipment and software took only a matter of a few hours.

Remedial uses for the microcomputer, especially in math fundamentals, were clearly the priority. The computer can serve as a tutor drilling the student on aspects of work related math, thus freeing the instructor to perform other teaching and mentoring activities.

C. RECOMMENDATIONS

The California community colleges are largely autonomous bodies functioning under the direction of boards of community college districts. They are less amenable to systemic influences than is, for example, the state university system. Leadership and initiative are matters of local or district concern. However, the E.H. White and Company project team has

several recommendations for the community college construction technology and carpentry programs vis-a-vis microcomputer use. They are as follows:

1. A very modest but focused effort should be undertaken to identify research, literature, software and other resources applicable to the community college construction education programs. This should include all resources in and outside of the community colleges that are available for training vocational education instructors in computer literacy and applications.

2. An effort should be undertaken to develop a network of vocational education personnel interested in using microcomputers in the classroom and the department. It is preferable if the network is subject specific (e.g., construction education).

   To some this may be counterintuitive because of the essentially separate and even isolated nature of the personnel from colleagues within the community colleges. This is in fact a major reason for developing such a networking effort.

3. The networking should grow out of an instructors' level task force on using microcomputers in the classroom. We are not at all impressed at the quality or appropriateness of the elementary and secondary level educational software for community college use based on what we have seen. We recommend that the task force look elsewhere for ideas and materials.

   The tendency to establish such bodies at the administrative level should be strenuously avoided in spite of the conventional wisdom that you need the administrator's support if any changes are to occur. At the least such a task force should have a majority of instructors.

4. The carpentry apprenticeship system should be included in this networking effort. While its goals are different, its curricula, methods, procedures and students are often quite similar.

5. A central clearinghouse should be designated to serve as a communication center and a collection point for the compiled resources. This should occur at the Chancellor's level; however, or at a host community college, presuming some modest resources.

   If a community college district is appropriate, the Peralta Community College District is a likely place to serve as the hub of such a network, given the interest indicated by their participation in this project.

The first priorities of the network coordinators and members should be to:

- o identify all interested instructors and their special areas of expertise and/or interest;
- o compile a list of all available resources (literature, software, people, and ongoing research);
- o develop a database to catalog and retrieve the compiled information; and
- o establish a communication channel within which the network can continue these tasks.

This incremental approach can begin to develop the interest, experience and knowledge necessary to speed the interest and use of microcomputers in vocational education.

APPENDIX A

PROJECT SURVEY FORM

Please return to: E.H. White and Company
245 Clement Street
San Francisco, CA 94118

THE USE OF MICROCOMPUTERS IN CONSTRUCTION TECHNOLOGY AND CARPENTRY PROGRAMS IN CALIFORNIA COMMUNITY COLLEGES

I. INTRODUCTION

E.H. White and Company, a San Francisco research and management consulting firm, is assisting the California Community Colleges adapt microcomputers to their construction technology and carpentry programs. This questionnaire is an important part of the research for the project. Your assistance is essential to form an accurate picture of current microcomputer uses and plans for its introduction in construction education.

The range of microcomputer uses includes, but is not limited to, these areas:

> Accounting and general ledger systems
> Job costing and client billing
> Project management
> Critical path scheduling
> Database and file management
> Mailing list management
> Financial planning
> Market research

The uses for microcomputers in computer assisted instruction (CAI) cover a wide range of areas including:

> Preparing class notes and syllabus
> Maintaining attendance and test records
> Maintaining equipment and supplies inventory
> Developing learning modules stressing real-world problem solving
> Using learning modules with built-in tests and quizzes

Computer assisted instruction seems to be developing along two lines. General instructional systems are being developed which can be used without a substantial understanding of computers or programming to build learning or testing modules. There are also software systems, often developed locally, which require programming and an understanding of microcomputers.

Please consider the plans, collective knowledge, interests and wishful thinking of your construction education department in answering the following questions.

THE USE OF MICROCOMPUTERS IN CONSTRUCTION TECHNOLOGY AND CARPENTRY PROGRAMS IN CALIFORNIA COMMUNITY COLLEGES

1. Community College

Name _____

Address _____

City and Zip _____

Dean, Vocational
or Occupational Education _____

Contact Person for
Computer Applications _____

Department _____

Phone Number (___) _____

Alternate Contact _____

Department _____

Phone Number (___) _____

2. Are microcomputers used at your school in construction education instruction? yes ____ no ____

if yes, please answer questions 3 - 5
if no, go to question 6

3. Make of computer(s) and operating system(s) used:

_____

_____

_____

4. Uses of the computer _____

_____

_____

_____

5. Software used _____

_____

_____

_____

6. Do you contemplate introducing (additional) microcomputers into your construction education program within the next three years? yes ____ no ____

if yes, please answer questions 7 - 8
if no, go to question 9

7. How will the microcomputers be used? _____

8. What are your software requirements or preferences? None _____

9. What is your priority wish list for microcomputer uses in construction education?

   a. _____
   b. _____
   c. _____
   d. _____

10. Are you interested in computer assisted instruction in construction education?

   a. ____ No, not now
   b. ____ Yes, if we can use it with a minimum of training
   c. ____ Yes, we want to develop our own
   d. ____ We need more information before we can answer
   e. Other _____

11. Are you interested in introducing microcomputer software that can be used in the construction trades?

a. ___ No, not now

b. ___ Yes

c. ___ We need more information before we can answer

d. Yes, we are interested in these areas: _____

12. What advice can you give us in defining priority areas for software applications for California Community College construction education? _____

13. What technical resources do you turn to in planning for or making decisions about using computer software in classroom instruction?

FOR NORTHERN CALIFORNIA CONSTRUCTION EDUCATION PROGRAMS

A northern California advisory committee will assist in designing the project. Please include nominations for this committee, using the following groupings, when returning the questionnaire. Sex equity is an important factor in selecting committee members.

1. Construction contractor
2. Building trade union official or member
3. Building association official or member
4. Construction technology or carpentry instructor
5. Recent construction graduate

Expenses can be paid for committee participation, where applicable.

Nomination, to group number _____

Name _____

Title _____

Address _____

City, Zip _____

Telephone number (___) _____

Nomination, to group number _____

Name _____

Title _____

Address _____

City, Zip _____

Telephone number (___) _____

Nomination, to group number _____

Name _____

Title _____

Address _____

City, Zip _____

Telephone number (___) _____

Nomination, to group number _____

Name _____

Title _____

Address _____

City, Zip _____

Telephone number (___) _____

APPENDIX B: DEMYSTIFYING THE MICROCOMPUTER

A. The Microcomputer in Education

As noted in the body of this report, none of the community colleges surveyed were using microcomputers in their construction education programs. However, based on the several computer labs we have visited in community colleges, it is clear that the microcomputers being used may not be the same as those used in the world of work.

In the elementary and secondary schools, the three most popular computers appear to be the 8 bit computers - the Apple IIe, the Radio Shack TRS-80, and the Commodore 64. In the community college computer labs the most popular computers seem to be the Apple IIe and the IBM-PC. Both of them have very good graphics capabilities, and in the case of the Apple there is a wide range of education software available. Unfortunately, we are not aware of much for community college vocational education.

B. The Impact of the Microcomputer

The microcomputer today is fast becoming as indespensable for the businessperson as the telephone. Therefore, it is important that students, instructors, business owners, professionals, executives, and office managers become familiar with this tool and the benefits it can offer.

This new technology is having at least three major impacts on the United States job market:

1. Displacement of existing occupations or industries.
2. Creation of new jobs within existing occupations, new occupations, and new industries.
3. Alteration of skills and tasks required within existing occupations.

The microcomputer as a business tool has several important functions:

1. It can assist in carrying our repetitive computations.

2. It can perform mundane, routine tasks and remember how to do them again and again.

3. It can provide rapid feedback of information important to making present and future business decisions.

4. It can model and simulate problems and solutions with minimal cost and time requirements.

Studying and understanding the business microcomputer should be approached systematically and realistically. For one thing, a microcomputer can have major ramifications for the educator and the business manager, creating problems for some while solving problems for others.

The purpose of this Appendix is to provide a realistic sense of the basic information a manager needs to know in planning for the introduction of the microcomputer into the organization or in planning for the upgrading of the company's computer facilities.

C. The Four Basic Elements of a Computer

A computer system includes individual components just as a good stereo system. They include:

1. **Hardware**, which is the machine itself;

2. **Software**, the instructions which tell the hardware how to perform a particular task like accounting or job costing;

3. **Input and Output Devices**, (peripherals) which permit the computer to communicate with the operator or other computers (e.g., terminals, printers, or modems); and

4. **YOU**, the operator, who, after some training and time spent being confused by instruction manuals, can make the system carry out your commands.

The typical business microcomputer system is made up of the processor unit (the computer itself), a keyboard device for word or data entry, a video terminal, a printer, and a magnetic disk unit to permanently store

the important information. These elements constitute the input (keyboard), the brain or logic (processor), the memory (main memory and disk), and the output (video terminal and printer).

The computer itself is made up of several parts, each part of which makes up a complete electronic circuit mounted on one or more circuit boards. Each circuit handles specific tasks within the computer. Typically, there are from several to dozens of circuits, including:

- Central Processing Unit (CPU), which performs calculations and logical operations;
- Memory, which stores information: there is random access memory (RAM) that stores information temporarily while the computer is on, and read only memory (ROM) that stores programs permanently but cannot be changed;
- Input/output (I/O) circuitry which permits the computer to communicate with the various input and output devices, such as the disks and printer; and
- Special function circuits, which help the computer complete tasks faster or more efficiently, such as clock/calendar circuits or memory management units.

The transfer of information from one part of the computer to another occurs along an electronic path known as a bus. The bus consists of signal lines that transmit the electrical signals. The speed and ease with which this information moves about is one measure of computer performance. Most computer manufacturers have their own bus architecture; however, there are several well known system buses that tie the internal workings of the computer together. The de facto standard is known as the IEEE 696/S-100 (or S-100) bus which allows the use of circuit boards from a wide range of manufacturers. This is especially important for specialized applications. Other system buses include the Intel "multi-bus" and the Digital Equipment Corporation (DEC) LSI-11 bus.

The CPU chip allows the computer to think. There are three main types of microcomputer CPU chips - the 8 bit, the 16 bit and the 32 bit. A bit stands for binary digit, either 0 or 1, which is the most basic piece of information a computer can handle. In moving information through a computer, it is clear that CPU chips moving 16 bits at a time are more efficient than those that only move 8 bits. However, for many computer applications, especially related to word and text processing, 8 bits are more than adequate.

The input/output board(s) connects the computer to the peripherals which can include the keyboard and video terminal, the printer, the telephone modem, and the plotter. Many computers use a standard interfacing procedure known as the RS-232 serial interface so that one peripheral can connect with many other brands.

Some peripherals use a different interfacing schema - parallel interfacing. When purchasing a microcomputer it is important to know the interfacing procedure for your machine and hence the type and range of peripheral devices available or the steps you need to take to add the proper interfacer boards.

D. Peripherals

The most common peripherals are the terminal, the printer and the modem. When purchasing a terminal there are several important items to consider:

- o the color of the characters - amber and green are the two most popular colors;
- o whether the keyboard is detached;
- o the feel and design of the keyboard - does it use the QWERTY standard, does it include a calculator pad, are there functions keys, where are the control and special purpose keys placed; and

o whether the display can be adjusted (tilted).

Good printers are quite expensive, often costing as much as the computer, although there are recent breakthroughs which will change this. There are four basic types of printers available:

Impact printers:

- o The dot matrix printer which is quite fast (60 - 250 characters per second (CPS)) but does not produce an image comparable to a standard typewriter;
- o The letter quality or daisy wheel printer which is slower (15-60 CPS), more expensive and noisier than the dot matrix printer but which produces a higher quality image. The report is printed with a NEC daisy wheel printer;

Sprayed ink printers:

- o The ink jet printer until recently has been very expensive, however they are now available at affordable prices. They are comparable to the dot matrix printer in print quality and speed, are quiet and do multi-color printing.

Laser printers:

- o Laser printers use an electrostatic charge wherein an image is transmited via a laser induced toner (like a photocopier) to the uncharged areas on the paper. While low cost laser printers are very new to the market, they offer the speed and versitility of the dot matrix printer, the quiet of the ink jet printer, and their letter quality approaches that of the daisy wheel printer.

The printer should be capable of providing the speed and quality of print needed. In selecting a printer you will almost always need a 132 column report format. The power of printed listings is to provide dense, meaningful information summaries. For many organizations the correspondence size (8 1/2") paper is sufficient. However, it you plan to do project scheduling or a lot of work with spread sheets, a wide carriage is indespensible. Be sure to specify a wide carriage, if you think you need one. Be certain to specify a "bi-directional" and "logic seeking" printer; these are fancy terms that means the printer figures out the most

efficient way to print a new line based on where it stopped printing the last.

Communications capability permits your computer to interact with others. There are many different communications protocols under the CP/M, MS-PC/DOS, Apple and TRS operating systems. The "standard" protocol has been the public domain (free) program called "MODEM7". This program usually communicates at 300 baud (about 30 characters per second) using the Bell 103 compatible, asynchronous format.

Some very excellent commercial programs are available, although most use proprietary protocols. The basic concern in purchasing a modem is compatibility. If you are considering purchasing one, determine what kind of hardware you wish to communicate with and what type of modem (if any) it utilizes. If you are interested in the subject, a very good resource is The Complete Handbook of Personal Computer Communications by Alfred Glossbrenner (St. Martin's Press).

The internal speed of the processor and the transfer rate of its main storage unit typically permit computational speeds in the range of many thousands of calculations per second. The speeds associated with keyboard inputs range from 10 to 200 characters per second. The speeds associated with output to printers range from about 15 to 500 characters per second and improving all the time. These differences between input, processing, and output make up one of the major considerations for determining the type of software and hardware to use.

E. Information Storage

A computer includes at least two types of memory. Random access memory (RAM) and mass storage memory. Memory storage occurs in bytes. There are eight bits in a byte and each byte makes up one character

(letters, numbers, spaces, symbols). In fact each character is made up of unique combinations of seven 1's and 0's with the eighth bit for parity checking. If a memory stores 1024 bytes, that is the same as saying that it stores 1024 characters of information. These characters are standardized by the American Standard Code for Information Interchange (ASCII) and referred to as the ASCII code set.

Information storage is generally too great to use bytes as the unit, so the term "K" bytes is used to refer to about a thousand bytes (actually it is equal to 1,024 bytes; therefore, the expression 64K bytes memory means 65,536 characters). A machine that is expandable to 1 megabyte of RAM means that more than one million bytes (characters) of random access memory can be used by the machine.

Random access memory is the memory that the CPU communicates with directly. This memory is volatile which means that the data are only stored as long as the memory receives power. To store the data permanently a mass storage device is needed which is non-volatile. A mass storage device can normally hold more information than can be held in RAM.

Every computer uses internal RAM memory to execute programs. New RAM chips are constantly being introduced with more memory at less cost, and there is no real reason why every 16 bit micro cannot have at least 256K of RAM (most 8 bit micros are limited to 64K, some can handle 128K). So, with 256K RAM memory there should be no problems in handling most software. This address space should be able to contain the operating system, software and data areas required to run your system.

There are many advantages to having a maximum amount of RAM. Nearly all commercial software packages use whatever memory is left over after their program is loaded to hold work buffers, indexes, etc. There is often

a vast improvement in performance between a package executing on a 128K machine and the same package running in a 256 to 512K micro, due to the larger area used for searches, sorts and indexes. The industry standard for RAM is fast approaching 256K, and many expect it to double shortly.

The two commonly used forms of mass storage are the diskette and the hard disk. Diskettes come in three sizes - 8", 5 1/4" and several mini-diskettes in the 3 1/2" range. The larger the diskette the more data it can hold, and the more rapid the access time. Eight inch diskettes are standardized for professionalized systems while the 5 1/4" and mini-diskettes are not standardized. The diskettes come in single sided, single density up to double sided, double density. An 8" double sided, double density diskette holds 1.2 M-bytes (over 1,000,000 bytes) of memory.

An easy way to get a sense of relative disk capacity is to compare the approximate page length obtained by increments of memory. For example:

100Kb characters = 50 pages	300Kb characters = 150 pages
200Kb characters = 100 pages	1.1Mb characters = 550 pages

The hard disk mass storage holds far more memory and can be accessed much faster. Hard disks come in different sizes and up to 40 megabytes is common.

However, mass memory storage technology is changing very rapidly which means that more information will be able to be stored on smaller magnetic media at a cheaper price. This means that all storage including the hard disk drives (commonly known as "Winchester" drives) will increase the density at which it can store information as will the diskettes.

A long awaited fantasy mass-storage media is the digital audio disk that uses laser technology to read and write to disk. According to a recent article this laser disk known as a compact or digital audio disk (CAD or DAD) may be able to store 3.3 gigabits or around 400 megabytes per

side and be more than four times faster than the diskette in transfering data to memory. The drawback is that the laser disk cannot be erased - at least in the near future. However,the amount of memory plus the ability to be mass produced has revolutionary implications as has each major advance in the industry.

F. The Three Types of Computers

There are three basic "sizes" of computer systems: mainframes, minicomputers, and microcomputers. The basic differences among them relate to the memory size, computational speeds, and cost. However, with the continually decreasing cost and size of the microprocessor chips while increasing computational speeds and useable memory, these distinctions have begun to blur.

The terminology among microcomputers is especially confusing. We hear of the lap computer, the portable and lugable computer, the home computer, the personal and the desktop computer, and the business microcomputer. The distinctions among them are based on the size and weight of the hardware, the amount of main memory and useable memory, the computational speeds and the cost. Certainly, these distinctions have always been blurred. What is also blurred is the degree to which the particular microcomputer can be upgraded as the organization's needs grow and change.

G. Microprocessor Type

Until fairly recently, most of the microprocessors used in microcomputers were 8-bit devices. These devices communicate with the outside world and perform most of their internal operations in 8 bit chunks. With the advent of the 1980's, these first generation microprcessors have been challenged by new generations of 16 and 32 bit microprocessors.

The 8 bit microprocessors have some intrinsic limitations that restrict the size and complexity of the problems they can be called upon to solve. The most serious constraint, in the year of falling memory prices, is their 64K byte direct addressing limit.

Another problem is that the 8 bit processor instruction sets are generally less powerful than those of the newer 16 bit machines. Many of the 16 bit processors are also being manufactured to run at faster internal clocking rates, thus executing more instructions per second.

Systems incorporating the new 16 bit or 32 bit microprocessors take advantage of their extended addressing capability to support a maximum of 256K to 16 million bytes of memory, depending on the system. By directly using this extended memory, software designers are able to solve much larger problems, or to write programs that provide much better user support and error handling facilities that can be accommodated on 8 bit machines.

Although the 16 bit machines generally run faster than their 8 bit predecessors, system performance as seen by the user is determined more by the efficiency of the applications software and the operating system than by the processor itself. In applications which demand enormous amount of processor time, such as engineering computations, statistics, or program compilations, the very high speed 16 bit machines show a clear advantage. With higher speed comes the demand for faster and much more costly components, especially memory.

The 8 bit machines typically run at between one and five megahertz (one megahertz = one million processor cycles per second). Nearly all of the new 16 bit microcomputer systems are running at about five MHz. If you have an application that justifies a faster processor, 16 bit microcomputers are available that operate as fast as 12 MHz.

Most of the 16 bit processors perform their internal operations and communicate with the outside world in 16 bit chunks, but there are exceptions. While the Intel 8086 is a full 16 bit implementation of the microprocessor, the most commonly encountered version is the 8088. The difference between the two processors is that the 8088 communicates with the outside world in 8 bit chunks. This retards its performance somewhat, but allows it to make use of the vast quantity of inexpensive 8 bit peripheral support hardware. The result is that the 8088 based systems (like the IBM PC) are considerably less costly than a corresponding system built on the full 16 bit 8086 processor.

Some manufacturers are using 8 and 16 bit or 16 and 32 bit processors to create systems incorporating two microprocessors.

The internal architecture of the processors varies widely. One of the most advanced is the Motorola 68000 microprocessor which employs a 32 bit internal architecture which can multiply and divide (a rare feature). These features make for "hidden" performance improvements exceeding those expected purely from higher processor speeds. The 32 bit internal architecture of the Motorola 68000 is a preview of the next generation of microprocessors, the 32 bit machines, that are now reaching the market.

Sixteen bit microprocessors can generally address much more memory, but their full capabilities are not always exploited. Microcomputer designers can limit the amount of memory you can place on the system through design decisions that cannot be undone. This reduces the cost of the hardware, but limits your future expansion options. The amount of memory you need on your microcomputer system is determined by the requirements of your most demanding application and by your plans for future expansion of your system. You should know how much memory is supplied with

the system and what its memory limit is.

If you plan to move to a multi-user system, you will need memory to support each user you add to the system. Some common applications packages work more efficiently, or can manage larger problems, if more memory is available. For example, word processing packages can more easily manage large documents if more memory is available; electronic spread sheet programs can handle larger grids if the memory is available.

H. Software

Software refers to the program and data. The program is a set of instructions which when installed in the computer's memory will perform specific actions. There are two basic types of microcomputer software - the operating system and the applications software. The operating system is a collection of programs which talk directly to the microprocessor and allows the components of the computer to interact. It allows the user to load software into the computer and to copy and store files and to carry out the basic user commands related to the development, use and storage of information.

Computer manufacturers either have their own operating system which is particular (proprietary) to their hardware or they use operating system software that is somewhat standardized among computers. The two most popular operating systems used today are the Microsoft Disk Operating System (MS-DOS) and its IBM version, PC-DOS, and the Control Program for Microcomputers (CP/M). Thousands of applications software packages are currently available for MS-DOS and CP/M. The most popular standard in 1984 is MS-DOS.

CP/M has been the most popular operating system for computers based on the 8 bit 8080, 8085 and Z80 microprocessors. Since its debut in 1975,

CP/M has been adapted to run on more than 300 different microcomputers. Even computers with incompatible microprocesesors like the Apple II and IBM-PC can run CP/M with the help on an extra circuit board.

CP/M is a no frills, single user, single tasking operating system. It only requires about 5K of RAM, which is important for the early 8 bit machines machines which could only support 64K bytes of memory, and usually only came with 24K of RAM. CP/M's big selling point is its previous success. Because of its popularity, programmers have written a lot of software for CP/M and today the operating system boasts the largest library of business-oriented microcomputer software. Also as a "mature" operating system, CP/M is relatively free of bugs and is supported by a library of detailed guides and books.

The manufacturer of CP/M, Digital Research, Inc., has not been resting on its laurels. It has developed a family of CP/M-related operating systems that run on newer hardware and offer advanced capabilities. Members of this family include MP/M II, CP/M-86 and Concurrent CP/M. MP/M II is a multiuser version of CP/M that can support up to 16 timesharing users on 8080, 8085 and Z80 based systems. CP/M-86 is a version of CP/M that runs on Intel's 16 bit 8086 and 8088 microprocessors. Concurrent CP/M rides the current wave of integrated software by offering a multitasking version of CP/M-86 that can run as many as four programs on the same system at the same time.

Largely because of IBM's decision to use MS-DOS, a competing CP/M look-alike operating system from Microsoft, on the IBM Personal Computer (PC), CP/M-86 has lagged behind MS-DOS in the 16 bit market. However, because CP/M-86 can share disks with CP/M, it is a favorite choice for dual processor machines like the CompuPro 8/16, the Zenith Z-100 and the DEC

Rainbow, which have both 8 bit and 16 bit processors.

Also, in an attempt to make Concurrent CP/M more attractive to MS-DOS users, Digital Research has recently produced Concurrent DOS which has the ability to run cp/m-86 and MS-DOS software. Users should now be able to get the best of two worlds - the multitasking ability of Concurrent CP/M and the large software library of MS-DOS.

MS-DOS is fast becoming the leading single-user, single tasking operating system for computers based on the 16 bit Intel 8086 and 8088 microprocessors. MS-DOS has the largest library of business-oriented programs for 16 bit microcomputers.

In its earliest versions, MS-DOS looked a lot like CP/M to the user because it included many of the same commands and functions. Beginning with version 2.0, MS-DOS began offering features more characteristic of Xenix, Microsoft's version of UNIX. Many industry observers speculate that Microsoft will continue to add UNIX-like features to MS-DOS, turning it into a multitasking system to compete with Concurrent CP/M.

Bell Laboratories (AT&T) holds the copyright to UNIX, a multi-user, multi-tasking operating sysem that has been popular since the mid-1970's on minicomputers like Digital Equipment Corporation's PDP-11. Microcomputer sound-alikes with names such as Xenix and QNX are now becoming available for 16 bit microprocessors. IBM has blessed UNIX by announcing that it will use its own version of UNIX on its IBM XT/370 and its 32 bit computer.

Microsoft Corp. is the largest distributor of UNIX for microcomputers. Its licensed version, Xenix, runs on 16 bit systems using the Intel 8088 and Motorola 68000 including the Tandy System 16, Fortune 32:16 and Apple Lisa.

Programmers like the UNIX-like operating systems because of the ease

with which they can string programs together with "pipes" and "filters". A pipe allows you to send results from one program directly to another, and a filter will perform operations like sorting or counting data as it moves from one file to another. This "toolbox" concept allows programmers to create systems with a lot of power and flexibility.

Another UNIX concept is the tree-structured filing system. This is a means of organizing the hundreds of data files that can fit on a hard disk into directories and subdirectories. Each subdirectory maintains a manageable number of files, say 10 to 20, and has a connection or path to other subdirectories. This approach makes a lot of sense in a multiuser system, where each user can control her or his subdirectories.

Because of their complexity, UNIX-like systems use a lot more memory than simpler operating systems like CP/M. For this reason, they are available only for the 16 bit and 32 bit microprocessors that can handle large amounts of memory. Many observers are betting that UNIX will become the leading operating system for the next generation of more powerful microcomputers.

Applications software gives the computer personality. This is the range of software packages which permit a computer to carry out a particular set of tasks (word processing, accounting, project scheduling, statistical analysis). The range of software applications seems virtually endless. The most common generic applications software are:

- o word processing
- o electronic spreadsheets
- o database management
- o accounting packages

- integrated data management packages which combine word processing or text editing with a spreadsheet, a database manager, graphics and possibly communications

Video games are a different type of software, more because of their purpose than anything else. The home computer video cartridge games come with read only memory (ROM) where certain instructions are imputed and limited choices are available to the user.

A third kind of applications software are the computer "languages" which permit the user to develop his or her own computer applications. Common computer languages include BASIC, FORTRAN, PASCAL, and COBOL with a host of more recent languages with names like MODULA-2, ADA, and PROLOG available.

APPENDIX C: OVERVIEW OF THE INFORMATION DISSEMINATION WORKSHOPS

A. Introduction

As part of the final information dissemination requirements of this study, two workshop/seminars were held: one at Cerritos Community College in Norwalk (near Los Angeles) on September 20, 1984 and one at Merritt College in Oakland on September 26, 1984. Project members included Harold Charns, Project Director and Mr. Denny Porter, Senior Researcher at both sessions and Mr. Jerry Reynolds, Senior Consultant, in Oakland.

Invitations and informational packets were sent to the Community Colleges in California which had been previously identified as having construction technology vocational education courses. Invitations were also sent to the project Advisory Committee members and to administrative orficials and instructors of the Carpenter's Union Apprenticeship programs for the northern California area.

The following individuals attended the September 20th workshop:

Charles Mull, Assistant Professor, Pierce Community College

Fred Lamm, Associate Dean for Occupational Education, Compton College

Ernest Maurer, Dean for Technical Division, Orange Coast Community College

Frank E. Denison, Jr., Professor of Construction Technology, Orange Coast Community College

Robert Leuford, Associate Instructor of Construction, Orange Coast Community College

Peter Gibson, Instructor or Construction Technology, Antelope Valley College

Robert Petri, Head or Construction Technology Department, Fullerton College

Jim Clarke, Professor of Construction Technology, Orange Coast Community College

Stephan Robinson, Professor or Construction Technology, Orange Coast Community College

Dr. William Boakes, Specialist in Technical Education, California Community Colleges Chancellor's Office

The following individuals attended the September 26th workshop:

Hal Dromensk, Construction Technology Instructor, Gavilan College

Ed Wicks, Construction Technology Instructor, Sierra College

Tom Castalbo, Coordinator, Sierra College

Terry Callan, Training Officer, Carpenters Apprenticeship Program

John Palmer, Training Officer, Carpenters Apprenticeship Program

Roger Tromoley, Training Coordinator, Carpenters Apprenticeship Program

Paul Knudson, Training Officer, Carpenters Apprenticeship Program

Bob Buckingham, Head of the Vocational Education Division, Merritt College

B. E.H. White and Company Presentation

Mr. Harold Charns, Project Director for the project, opened the program with a brief overview of the entire project, the genesis by which it took form, and the unforeseen difficulties which arose in trying to obtain both hardware and relevant software. It was noted that the computers were well received by the instructors who used them, and the students who took advantage of their being available in the classroom.

The attendees were then asked to identify themselves, their position and their school, and their interest and current knowledge level and use of microcomputers.

Reference was made to the working papers available in the workshop handout packages. These included the following:

- Executive Summary (a copy of the executive summary in this report)
- Workshop Paper No. 1 (a copy of Section II in this report)
- Workshop Paper No. 2 (a copy of Section III in this report)
- Workshop Paper No. 3 (a copy of Appendix B in this report)

Mr. Dennis Porter, Senior Researcher presented a brief overview of the uses of microcomputers in the construction trades and in the construction technology classroom. Reference was made to Workshop Papers No. 1 and 2.

After a 10 minute coffee break, Mr. Porter continued with a discussion of the three demonstration projects. Included was the background on the selection process, the priority "wish list" of the instructors for use of the microcomputer in the classroom, the hardware and software used, and the results and conclusions for each site.

C. Microcomputer and Software Demonstration

The workshop/seminar concluded with project members giving a hands-on demonstration of the three microcomputers, and their software packages, used during the demonstration project.

APPENDIX D: MICROCOMPUTER SOFTWARE RELEVANT TO THE CONSTUCTION TRADES

The following materials are taken from various sources to provide information on the software (computer programs) currently available for use on microcomputers. The majority of this appendix is a comprehensive description of software taken from the notebook supplied in the full-day seminars conducted by Micro Methods, Inc. The balance of the appendix is several reprints that contain additional information on microcomputer software.

Additional information on microcomputer software relevant to the construction trades can be accessed from a data base that covers the complete range of construction computer news from acquisitions to detailed reviews of construction software from 1981 to the present:

Producer: Construction Industry Press
1105-F Spring Street
Silver Spring, Maryland 20910
(301) 589-4884

Available on: NewsNet, Inc.
945 Haverford Road
Bryn Mawr, PA 19010
(800) 345-1301
(215) 527-80300

And, finally, some simple but useful programs can be found in publications such as School Shop or New Shelter magazines. These are usually Basic program listings written for a particular microcomputer (usually an Apple II-e or a Radio Shack TRS-80), but someone with a familiarity with the Basic language can easily modify them for almost any other computer system.

WORD PROCESSING AND BUNDLED SOFTWARE

Word Processing

Until a few years ago, word processing software was minicomputer based and expensive. The microcomputer systems available were dedicated to word processing, and while they were easy to use, the computer was limited to word processing alone. We are now in our third generation of microcomputer word processing programs. They take a while to learn if you have not used them before, but have good help commands and are reasonably well documented. They can improve office communications when used thoughtfully.

Beyond the use of typing and text formating, word processing is typically used for such purposes as:

- Form letters where large quantities of personalized form letters can variably change such information as name, address, date, or specific information;
- letter and memo typing;
- document creation including the text for bids or boilerplate for contracts which should be changed from time to time (in which process documents can more easily be prepared, edited and revised); and
- records processing that requires the creation of a database of formated information that can be amended at any time and sorted.

The "better" word processing programs provide full screen editing which requires customization for your particular hardware. Full screen and printer editing requires special control codes for cursor control, boldfacing, underlining super and subscripts, and formating. Features to look for in a word processing package include such features as:

- Insert/delete;
- global search and replace;
- text justification;
- footnoting;
- indexing;
- automatic pagination; and
- hypenation.

Figure 4:

Best Selling Word Processing Software
February 1984

Ranking		Months on Chart	Word Processing Package Publisher - Systems	Cost
February 1984	December 1983			
1	1	13	Wordstar - MicroPro - Apple, IBM, DEC, TI, CPM	$495R $269D
2	2	13	Applewriter II - Apple - Apple	$150R
3	4	5	PFS: Write - Software Publishing - Apple and IBM	$140D (IBM PC) $125D (Ap.IIe)
4	3	8	Bank Street Writer - Broderbund - Atari and Apple	$69R $45D
5	5	13	Easywriter II - IUS - IBM, DEC and TI	$350R $239D
6	6	4	Multimate - Softword Systems - IBM	$495R $299D
7	7	9	Word Juggler 2.2 - Quark - Apple	$295R
8	-	-	Wordperfect - Satellite - IBM	$495R $375D
9	8	10	Work Handler - Silicon Valley Systems - Apple	$199R $115D
10	-	-	Perfect Writer - Prefect - IBM and CPM	$389R $149D

Source: Microworld, Auerbach, Inc., February 1984.

D - indicates discounted price
R - indicates suggested retail price

Figure 5:

System Capabilities of Word Processing Best Sellers

Package	Block Move/Copy	Centering	Document Orientation	Formula Printing	Global Search/Replace	Headers/Footers	Margin Justification	Math Functions	Menu Driven	Operator Help	Pagination/Repagination	Records Processing	Spelling Dictionary	Stored Print Formats	User-Defined Keys	Windows
Wordstar	x	x	x	x	x		x	x		x	x	x				
Applewriter II	x				x											
PFS: Write	x		x		x					x					x	
Bank Street Writer	x		x		x					x					x	
Easywriter II	x	x	x		x	x		x	x	x		x	x	x	x	x
MultiMate				x	x		x	x				x	x		x	
Word Juggler 2.2	x				x					x				x	x	
Word Perfect	x	x	x	x	x	x	x	x	x	x	x	x			x	x
Word Handler	x			x	x			x							x	
Perfect Writer	x	x		x	x		x	x	x						x	

- integration with mailing list, spelling checker, spread sheet and data base software
- clear documentation
- center a line
- create tabular material
- merge two files from the same or different diskette

Word processing software is especially useful when the firm has regular correspondence, and other text like bids, contracts, subcontracts and communications which require editing but need not be rewritten each time. Diskettes take the place of file cabinets for storing the master correspondence. Master contracts can be prepared with the proper changes for each situation.

Figures 4 and 5 compare several of the popular word processing packages. These workshop notes were written on Wordstar.

Bundled Software

Some microcomputer manufacturers include software with their computer system. This is known as "bundled software" as it is bundled into the offering. If a firm is small and looking for a single user start-up system that can be later expanded, it is smart to consider whether software is including in the price. It is not unusual for word processing, an electronic spreadsheet, some file management, and even a accounting system and data base management system to be included in the hardware purchase price.

Electronic Spread Sheets

The introduction of microcomputers into offices was helped by the the first electronic spread sheet package, Visi-Calc in 1981. Similiar packages and later versions which integrated several features with the spread sheet have been the largest selling microcomputer packages. Spead sheets are now in their second generation and still extremely popular for the small business owner and manager.

These packages enable the user to create models or programs by entering assumptions into appropriate rows and columns and creating relationships (formulae) among the cells (intersections of a particular row and column). This format is much the same as an accountants columnar pad. They are extremely versitle and after the initial confusions they are easy to use.

The electronic spread sheets have grown popular because of their usable and versatile applications including:

- budgetary forecasting and control
- cash flow projections
- bid preparation
- job cost analysis
- business planning
- tax preparation and analysis

The first generation spread sheets have almost all of the essential power of the second generation programs, but do not have the advanced formats and functions of the newer programs.

This generation grows out of the recognition of several limitations - the desire for more memory, the ability to link individual spread sheets together into an intergrated system of sheets, more powerful arithmetic and formatting funtions, and more fully integrated graphics, data base management and word processing/text editing.

The better electronic spread sheet applications have some of these features:

- at least 64 columns by 254 rows
- a convenient and economical command language
- a simple command to force recalculation of the entire spreadsheet
- the ability to work with two spread sheets or sections of one spread sheet, view them in split windows and switch back and forth between windows
- prompt lines and a help menu
- ability to enter labels, values and formulae in any cell
- ability to specify column widths
- a build in set of function commands (logic, square roots, minimum or maximum)
- ability to replicate and copy cells and rows or columns
- ability to protect the contents of any cell, row, column or block to prevent overwriting or new data

Figure 6 is a comparison of several electronic spread sheets. There have been recent improvements in them, primarily upgrading

Figure 6:

Comparative Features Chart -- Spreadsheet Packages

Package	Operating System		Documentation		Spreadsheet Size		Data Entry				Worksheet Formatting				Built-in Functions			Enhancements			Price
	CP/M	PC-DOS/MS-DOS	Tutorials	On-Screen Help	About 62 x 255	Other	First Keystroke Distinguishes Label & Number	Editing of Formula & Label	Names Cells for Use in Formulas	Replicate Rows, Columns	Adjust Col. Width, Col. by Col.	Display Formulas in Each Cell	Display Calculated Results	Protect Cell, Col Rows, Blk Cntnts	Logic	Search	Finance Statistics	Recalculation Automatic or Manual	Multiple Windows Split Spreadsht	Consolidation of Multiple Sprdshts	Interface with Other Software	
CALC STAR	X			X	X	127x255		X					X	X	X		X	X			X	$145
CONTEXT MBA		X	X	X		95x999		X		X		X							X		X	695
LOTUS 1-2-3		X	X	X		255x2048		X		X		X	X	X	X		X	X	X	X	X	495
MULTIPLAN		X		X	X			X		X			X		X		X	X	X	X	X	275
PEACH CALC		X			X			X	X				X				X	X	X			375
PERFECT CALC	X	X	X	X	X		X	X		X	X	X	X	X	X		X	X	X	X	X	295
SUPER CALC	X	X	X	X	X		X	X			X	X	X	X	X		X		X		X	295
TARGET FINANCIAL PLANNER	X	X	X	X		1Kx50K		X	X	X	X		X				X	X		X		325
VISI CALC		X	X		X			X		X			X		X		X				X	250

NA = Information not available.

them to integrated data mangement systems. Before purchasing one, at the least ask about technical reviews on them reported in such publications as **InfoWorld.**

Integrated Data Management Packages

A useful and currently the most popular software application is the integrated data management application. These packages combine some word processing features, with the data base management system (DBMS), a spread sheet, graphics and possibly a communications (computer to computer) module. In order to provide all these features, the individual modules cannot be as powerful as their stand alone cousins. Usually each package will have one module which is the strongest or most powerful. This is important to know when making choices.

The beauty of these integrated packages is that they operate with one set of commands and one can hop back and forth or use windows to interrelate the functions. For example, data can be selected from the DBMS, analyzed further on a spread sheet, summarized via the text editor and displayed with graphics.

The most popular integrated data management application is LOTUS 1-2-3. It has a second generation version, Symphony, which has also been reviewed favorably. Other popular versions are Context MBA, SuperCalc3, Peach Text 5000 and Visi On. **Because of the extensive memory requirements associated with graphics, pay particular attention to the RAM and static memory requirements of these applications.**

Figure 8 is a comparison of several integrated "spreadbase" packages. Although SuperCalc3 is not included, it should not be overlooked when making your choice. Should you drop your first generation program in favor of a spreadbase like Lotus 1-2-3? There certainly are advantages, especially if you have a graphics terminal or printer capable of printing graphic displays, but, it depends on how you use it. However, if buying a spreadbase for the first time, get an integrated one.

Templates

There are add-on programs called **templates** which make certain kinds of applications more powerful and easier to use. For example, the Template People, P.O. Box 1029, Crestline, CA. 92325 advertise a construction job cost template that helps organize almost all the costing functions related to an estimate or project budget. It costs $49.95 and works with VisiCalc, Supercalc, and Multiplan.

Data Base Management Systems (DBMS)

A data base identifies a set of data that the computer can access and manipulate. By comparison, a data base management system is a tool for solving information problems related to

Figure 7:

Comparison for Integrated Spreadbases

Vendor/Package	Operating System	System Capabilities: Data Base Management	Graphics	Spreadsheet Modeling	Terminal Emulations	Word Processing	Mouse Based	Operating Environment	Windowing	Price
Business Solutions Jack 2 The Incredible Jack	UCSD p-System Apple DOS/SOS	X X	X X	X X		X X				$495R $179R
Context Mgmt. Systems Context MBA	PC-DOS + UCSD p-System	X	X	X	X	X			X	$695R $459D
Executec SeriesOnePlus	CP/M 86, PC/MS-DOS Unix, Xenix	X	X	X	X	X		X		$495R
Lotus Development 1-2-3	Apple DOS/SOS PC/MS-DOS	X	X	X						$495R $329D
Software Products Int'l Open Access	PC-DOS	X	X	X	X	X			X	$595R
Visicorp VisiOn	PC-DOS		X	X		X	X	X	X	$495R

information stored on disk. Data base management strategy contrasts markedly with the approach used under management information systems. That is, under a MIS, each application or program is connected to its physical data. Thus, an accounts receivable file and an accounts receivable customer file were connected with the accounts receivable ledger and the sales inquiry program. Under the DBMS, the applications or computer programs have a logical view or access to the data that are independent of how the data are physically laid out on the disk. The data on the disk can be changend or supplemented without requiring program changes.

Data base management systems make sense in any situation where an organization has a mass of files to be logically stored, retrieved and periodically manipulated. These systems could be used for such tasks as maintaining inventory, fixed asets, market research, personnel administration and accounting systems. The attached case study is one example how a DBMS was used for maintaining personnel data.

There is a special terminology used with DBMS. A file is a collection of data on a disk accessed by a unique name. It generally contains a sequence of records of identical format, each containing a series of fields. It may include a data dictionary, an index, a screen layout, or any combination of the above. A record is a group of related fields of information treated as a unit. A field identifies a location in a record where a data item is stored. This field has certain characteristics, such as length and type (numeric or character string). Open files indicate the number of files which can be opened simultaneously so that a user can address different files and print them in a report all at once. A schema is a logical picture of the data base showing the relationships between various records. The detailed contents of the records come from the data dictionary. A data dictionary is a full description of the field in a data base. It describes the relationships between various fields in a data base, and it describes each field by name, report heading tag, length, data type, and high and low limits.

To apply these definitions, a potential buyer would first have to come to a understanding of his or her needs by specifying output requirements, input requirements, determining file structure and forms design. Based on this, the user will pinpoint: number of files, number of records, number of fields or variables, field size in number of characters, open files for accessing multiple fields and the report generation features. For example, one user chose Selector over dBaseII because Selector featured a menu-driven program, 89 fields per record (dBase II allows up to 32 fields per record), seven open files (vs. dBase II's two) and Selector's ability to generate reports in a non-columnar format.

The DBMS software varies a great deal in its power and ease of use. It brings substantial versatility and power to the

microcomputer, but care should be used in applying it in the firm. To understand the value of the DBMS, it is important to distinguish it from file management software.

File management software is useful in maintaining and using a single file of information (related records about a topic). DBMS software creates data files, allows the individual records and the files to be integrated through extensive programming alternatives. The files can be indexed allowing ease of access by a range of fields (name, address, city, state, zip, phone #).

The most popular DBMS is also the most complex, dBase II. It is used to generate mailing list, student records, accounting systems, inventory programs with very large files (if organized with discretion).

The command languages in DBMS are powerful, which is helpful to a programmer but sometimes frustrating to the occasional user. Therefore, it is important to seriously analyze the extent to which you need create electronic data bases before considering which, if any, system to purchase.

Many database systems provide a means to interface their files to workprocessing and electronic spread sheets. The most popular DBMS are "relational" in structure. This means that the records of a file correspond to rows and the fields of a record correspond to columns. Other structures are File Management System and Network/Hierarchial.

A good DBMS should include these capabilities:

- screen/forms generator with full screen editing feature
- extensive and powerful data manipulation commands
- convenient indexing and access
- multiuser/multiterminal record locking
- relational database definitions
- facilities for easy file creation

The attached article gives a good overview of the features of the DBMS. **Interface Age** does a very good job of comparing and contrasting business software applications and is a good magazine to use in researching applications.

Case Study
Using a DBMS for Personnel

Firms can purchase personnel software,[1] but this application lends itself to a DBMS. That is, it can keep track of hiring and firing people, employee qualifications, salary reviews and changes, merit raises, performance appraisals and obligatory insurance forms completion. Even the minutia of personnel administration such as requests for checks, deductions for FICA, etc., can be handled. Using a small computer with any one of several database or spreadbase packages, managers can juggle employee or outside consultants' hours and human resource allocation in keeping budgets, training and project schedules, handling recruitment, etc. Small corporations can also generate complete reports, benefit statements, salary surveys and employee performance appraisals.

At more of the divisional or decentralized level, some organizations maintain information about their employees' salaries, project schedules, etc. In effect, personnel records will be controlled at the divisional level or at the source, with the organization's overall personnel data being maintained and periodically updated on the organization's mainframe computer. Such divisional records would be periodically audited and access to their contents restricted to authorized personnel.

A stand-alone small computer can handle the necessary personnel data for organizations having as many as 5,000 employees, depending on the amount of memory on hard disk. For companies with more than 5,000 employees, the advantage of small computers is that you can use them as terminals to extract data from a mainframe computer, and manipulate that data independently.

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[1]Personnel Manager and Manager Program Collection (Datamersion Corp., Northbrook, IL), integrated time and personnel management programs; DB Master from Stoneware (San Rafael, CA).

Decision Support Systems

There is a good selection of analytical tools available to the manager. Examples of the generic uses are:

- financial modeling
- statistical analysis
- linear programming
- general purpose problem solving

These software packages are more limited in number and reviews on them can often be found in InfoWorld.

Other Management Applications

There are several other management applications available which should be noted. Personnel management packages, or modules are beginning to appear although the more complete ones are expensive and often linked to micro-mainframe configurations.

Professional timekeeping and billing systems are available. They are of particular interest to attorneys but have wider application when different billing rates for different staff are used.

Other programs of possible interest include:

- fixed asset management
- business graphics
- desk organizer
- stock market retrieval system
- mailing list management
- communications
- taxes

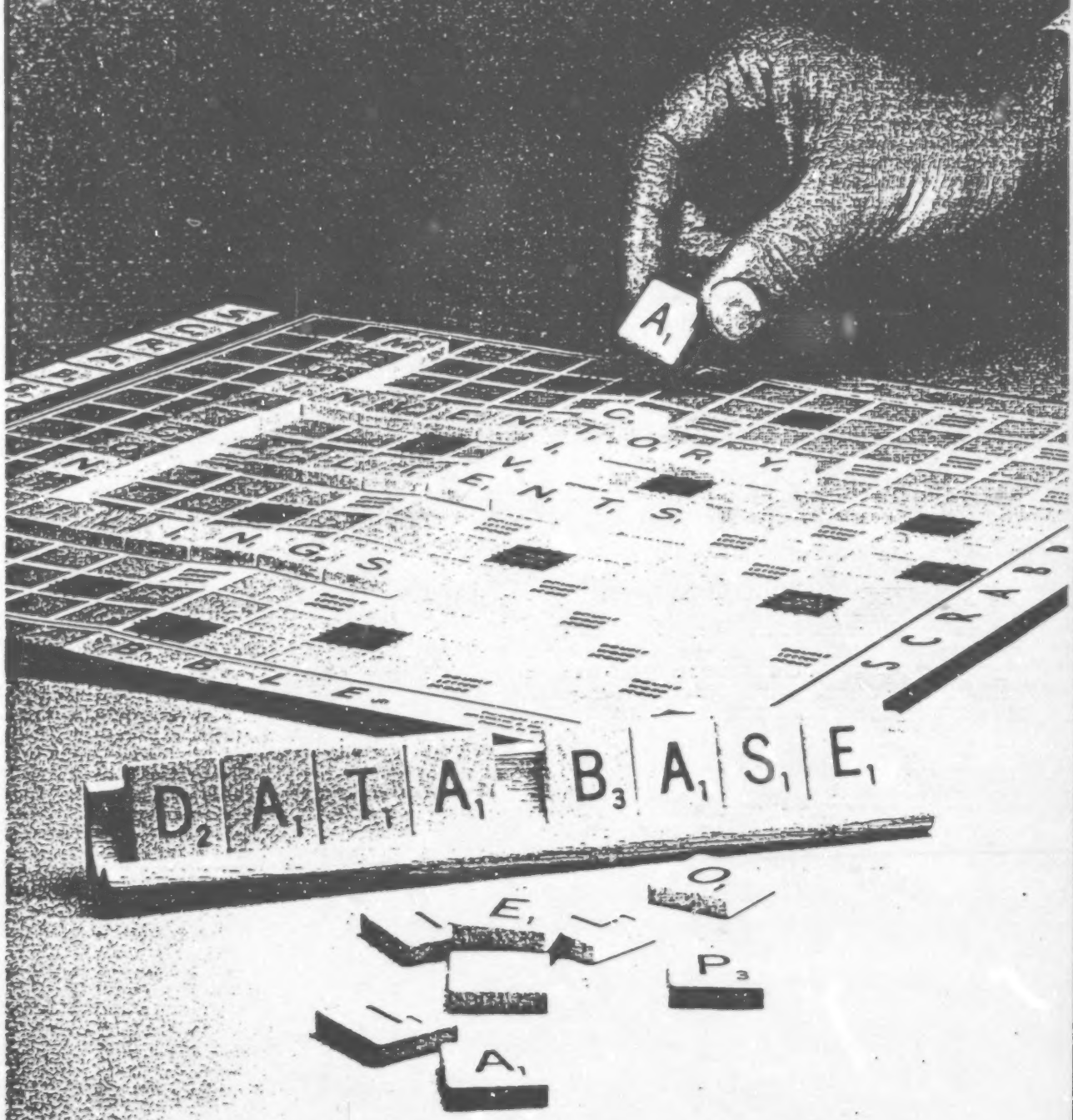
A Cautionary Note

The advantages of including the generic management software in your initial computer purchases should not overshadow your priority software needs. Don't be sidetracked by the bundled offerings if they are not what you need or if they cannot interface with other software that you intend to buy or communicate with. However, if they meet your priority needs, and the hardware that the bundle accompanies meets your three year planning needs, then you stand to save a substantial amount of money by taking the bundled offering.

SPECIAL REPORT

Solving the Data Base Puzzle

by Carl Heintz, CPA



Data base programs can be the most effective computer applications available. However, it is vital to understand both their capabilities and their limitations.

The term *data base* is one of those high-tech terms that nearly everyone is familiar with. Unfortunately, a lot of confusion exists as to what a data base really is and what the average computer owner can do with one.

Data base programs encompass a wide range of products, each with different capabilities. They include file management systems, systems for creating application programs (code generators) and true data base programs. All the programs share the ability to provide the user with the power to create, manipulate, and report on data files created according to user specifications. A data base program is a general program, as opposed to a specific application like accounts receivable. What is a data base?

Through a lot of abuse and misuse in the microcomputer industry, the term data base is not as precise as it once was. Unfortunately, just about every program seems to claim some form of data base organization. It's confusing, even to professionals.

From a purely theoretical standpoint, defining a data base is simple. It is a file, (or a group of files) that consists of a collection of interrelated data in a structure that provides links between elements in the file. In the world of mainframes, the definition includes some additional requirements about the way in which the data elements are related to each other. However, for the microcomputer environment, a data base has been redefined to include virtually any collection of data in files. Data base programs are those applications that are designed to allow users to create files and utilize the microcomputer to maintain information in an organized fashion. In the micro environment, there is often no distinction between a file management system and a formalized data base system.

For a program to qualify as a data base, it must allow its user to create custom files and inquire about those files in different ways. The user must be able to create reports and lists that are organized according to selection criteria of the user.

The concept of a data base implies that somehow each of the data elements are connected to each other—that they share some common relationships. There are many ways in which these relationships can be systematized, but in the current microcomputer environment the buzzword seems to be *relational*. The problem is that most users have little, if any, knowledge of what that term really means, and there are more than a few industry people with the same lack of clarity.

A relational data base

In theory, a relational data base is one in which each data element is an independent item linked to every other related element by a series of complex relational links. A true relational data base allows the simultaneous update of numerous types of information as the result of these links. Also implicit is an elimination of redundancy. If the data base contains a data element "New York," that element will appear only once in the data base. Links and Pointers to all other data elements that are related to New York will organize the data structure. Does it sound complex and esoteric? It is. It also requries a tremendous amount of computing horsepower and memory requirements to effectively implement. What one can accomplish with a $200,000 package running on a mega-mainframe is not about to be found in a $500 package needing only 48 KB RAM. On the other hand, a properly used data base system on a micro can produce results that are impressive by any standards.

Many so-called data base systems are really nothing more than file management systems, a much simpler operation than a true data base. Basically, all a file manager does is allow a user to create files, update them, sort them in whatever order is required, and finally create reports from the data. Each data element is independent, and only through the sorting process or the indexing process (in which keys or pointers to the records are sorted) are records ordered. In other words, with a file management system, records are kept individually, with no relational tags to link them together. Instead, the process of ordering records is done by sorting the records according to various attributes.

The vast majority of data bases for micros are in essence fancy file management systems. While every effort was made to clarify whether the data base systems included in our survey are really file management systems, the conclusions were often understandably difficult.

Some data base programs are in reality designed to be used as tools to create finished applications programs. They are essentially code generators that are meant to be used by the skillful user to create custom programs with specific data and file management. These programs may allow the user to create menus and data input screens, custom processing routines, and different types of reports that extract data from the files. With a little skill, a user can produce a program that looks like it was programmed from scratch by an expert. The data base program itself may be almost transparent to the user after the application is generated. A good example of a program developed in just this fashion is the Champion accounting program, which is written in Dbase II.

Inquiry programs

Other programs are really unsuitable to be used to generate finished applications programs. They are intended to serve as inquiry programs from the console, or they may have internal menus to help the user in the selection of data base functions. TIM is an example of a data base system that is not intended to create finished applications—its presence is always indicated by the complete menus used to guide the user through the various options available.

A data base program can be one of the most useful programs a computer owner has. It can be used as the focal point for the development of a complete application, or only as a utility program to fill in special needs not met by other applications products. A data base is a general program; its uses are limited only by the imagination and ingenuity of its users.

The basic data base does nothing more than allow a user to create a file to his/her own specifications. In other words, if a name and address list needs to be computerized, a data base program will allow creation of a file into which those records can be entered. The fields, or types of data to be input, are totally at the discretion of the user within the physical constraints of the system. In addition to the normal fields, for example, a field listing the most recent date that clients were seen might be needed. A regular commercially available name and address list program wouldn't have this flexibility—but with a data base program, it can easily be created.

Once the data base program has created a file structure for the name and address list, all data can be input. Later, reports can be created that list the information. One might wish to create a mailing label run or an alphabetical list; perhaps a list by city is important. Whatever the requirement, a data base program can provide the necessary flexibility to accomplish your goals.

Beyond these basic applications, there are more complex and sophisticated uses for a data base program. In the hands of a skillful user, the data base program can be used to create complete applications programs, some of which may be indistinguishable from commercially available software. Most users imagine that they will utilize data base programs this way. However, few users will ever have a data base program that is as polished and bug-free as a regular pre-packaged software program. Their aspirations will be countered by the facts of programming: it is a tough, tedious, and complex affair, even if the user has the strong tools of a data base program available.

Most computer users can think of at least half a dozen good applications for a data base program. Since they are so generalized and adaptable, no complete microcomputer installation should be without a good data base program. The problem, of course, is how to decide which program is the right one.

How to choose a data base

Choosing a data base system is not an easy task. With so many products on the market today, there is a lot of confusion as to which products are really the best. Choosing a data base is something like purchasing a car: There are many different models to choose from. Each one has its good and poor features, and each has a unique style. To evaluate the market's offerings effectively requires knowledge of how the system is to be used and what the skill level is of those who will use the system. Consequently, the criteria that each user has will depend upon that user's needs. However, there are some basic guidelines for making an intelligent choice.

The first characteristic to look for in choosing a data base program is a system that matches the skill level of the user. It doesn't make much sense to purchase the Excaliber DBMS, which can outperform three Cray mega-mainframe computers in tandem while using only one disk drive and 48 KB RAM, for example, if no one can understand how to implement or use it. Some of the products on the market, quite frankly, are designed by programmers for programmers. Without a good background in microcomputers, chances are the user will get confused, frustrated, and lost before he/she

Star Art Company: A Case Study

The Star Art Co. (Los Angeles, CA) is a specialty dealer in fine art objects. The company rejected all the conventional inventory and sales order entry programs because the commercially available software is intended for use by wholesalers—more appropriate for auto dealers than fine art. The company also wanted to have the flexibility of reports that were summarized specifically for a fine-arts dealer.

Convinced that a conventional inventory program would not work, the company investigated the cost of designing a custom program in Basic. The costs were prohibitive. The company's accountant then suggested using Dbase II to develop a custom system. This immediately sounded appealing, so a copy of Dbase II was obtained and the process of programming begun.

It's unfortunate that almost no software explains the art of programming. Whether using Basic, a data base manager program, or machine language, there are certain things that each program must contain if it is to be successful. These things include: relevancy to the application (the program must do the job intended, and integrity (it must be bug free and designed to to minimize error). Programs must also work logically.

The basic problem with most accounting applications is that they involve several different objectives that must be accomplished simultaneously. Even some accountants have a hard time conceptualizing the interactions that must take place in a computer accounting application. A sales order entry and fulfillment system involves numerous activities, including gathering customer information, inputting order information, checking inventory status, deleting items from inventory, adjusting accounts receivable, accounting for cash received, updating sales information, updating backorder information, adjusting commissions files, and printing invoices.

That's a complex assortment of tasks. When Star Art's management first thought of using the system, they really hadn't thought it through; most users don't. It is easy to think conceptually, omitting many details. It's only when the application is analyzed in-depth that most users realize there is reason why pre-packaged software is so expensive.

The first step in the process was to determine what the application really was. It's easy to say sales, but as the list of functions indicates, there's often much more to even a simple application than meets the eye.

The company began the process by designing the files that it would need to accomplish the tasks. Fortunately, the accountant helped out. He was able to input some important information that might otherwise have been overlooked.

The data files that the company established included a customer data file containing all of the information about the customer (including the last invoice number and certain marketing information, such as art preferences), an inventory file (containing all of the information about the inventory, including costs, sales price, source, and description), and a sales order file, consisting of a record for each sales invoice.

The next step in the process was to flowchart the entire process of order entry. This took about six hours, since as soon as a simple flowchart was developed exceptions became apparent. Soon the order entry flowchart became very complex. The company had gotten trapped in a mire of details. The accountant suggested that there might be a simple approach to the problem and began to eliminate functions that were not critical. Finally, the group came to a consensus that the important parts of the program consisted of taking order entry information about customers, creating an invoice or sales order, updating the inventory file for a purchase, and updating the inventory file for a sale.

This simple system was then translated into a series of steps for a program to be written in Dbase II.

None of the management had any previous experience with Dbase. The manual accompanying the program has an excellent tutorial that explains most of the functions, and the program disk includes several sample programs. However, developing the agility to program effectively in Dbase requires more than a casual knowledge of the product. Unfortunately, the attitude taken by the management of the company was that "if they say it's so simple in the ads, it must be..." No training time was anticipated, and no

gets halfway through the instruction book.

On the other hand, there are a few programs that have been designed as simply as any DBMS (data base management system) could be. They are targetted for novices, and will be more powerful in the hands of those users than the Excaliber system simply because they will at least be used.

There's good reason for knowing the level of a DBMS program since one designed for a novice will not have the power and flexibility of one designed for professional programmers; it will have to lack a lot and include a number of compromises in order to keep the whole process simple. The Personal Pearl system is a classic example. Users are given simple menus and really don't need much knowledge of computers or programming. At the other end of the spectrum is the FMS-80 system, which has a somewhat intimidating manual at first glance but all the power needed to create immensely complex programs.

What is it designed to do?

The second criteria for selecting a DBMS program is determining what the program is intended for. Not all DBMS systems are designed for the same purpose. Unless the user buys one that is oriented toward his needs, getting results may be impossible.

In the simpler systems, the user interacts with the program via a built-in menu. Intended primarily for inquiry, it's not designed to create finished applications programs.

At the other end of the spectrum are programs that provide very little in the way of user directions. These programs may have few, or no, menus. Many of them are intended to be used as program generators—systems used to generate custom applications programs. They serve to dramatically reduce the task of generating an application program and provide the user with the capability of creating custom applications without having to hire a programmer to do it. For example, a company might need to track open jobs in the shop. With a data base system, this task could be accomplished by establishing a file and inputting information as appropriate. Data about the progress of each job could be entered, and when necessary a report generated showing the status of each job. The shop foreman could inquire at a terminal to determine the status of any particular job, or to locate jobs being done for particular clients by specifying certain parameters and letting the system find the information.

Many novice computer owners assume that with a data base program they are going to be able to produce finished applications programs that will rival even

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educational aids were purchased to help with the task.

The company began by setting up the data files. That was a simple task which took less than an hour to do. Then, copying a program found in the samples provided on disk, a menu program was created. That was also relatively simple, taking less than two hours to do. The hard work had not yet begun.

The next step was to create a program to input both inventory items on hand and those received. Rather than create a complex system with numerous verification features and a complex system, the company merely called the append feature from Dbase. That feature allows adding a record with a format screen provided by the program. It is a simple program, with no real protections or edits, but it worked. There were some dangers that the company accepted in doing it that way. First was the possibility that more than one item might end up with the same inventory item number. The second risk was that the information input might be erroneous and there were no checks and balances that would catch things like duplicate entry of the same item. On the other hand, the simplicity of creation made the choice rather clear.

The next step was to create a program that would allow the entry of customer information. Again, the append feature of Dbase was used, with the same risks in data integrity.

The final step was to create a program that would input sales information, create an invoice, update the inventory, and create sales information. This step was the most difficult from a conceptual standpoint since it involved the creation of a program of Dbase commands. This was definitely not a good idea for the first Dbase program the company created. The struggle that went into writing the command file was equally matched by the computer's inability to deal with numerous syntax errors. Unfortunately, Dbase is not a particularly good debugging tool.

The group was able to write the code in three days but required more than two weeks to debug it. The program was only five pages long, not especially long as programs go. The test of the documentation was in determining why things went wrong. Unfortunately, none of the group (except the accountant, who had completed a course in Fortran at school years earlier) had ever had any real programming experience. The one saving grace was that the CPA remembered the debugging procedure he had used in school: putting in a line of code that would print something on the screen at various stages of the program—a tracer so to speak. By imbedding these various messages, the group was able to see just where the program was not working. That solved the syntax errors. It did not solve the logical errors.

After a two-week stint at learning the syntax of Dbase the hard way, the program worked (after a fashion), but it became painfully apparent that there were many loose ends that were unforeseen. Some of the problems included what to do if an inventory item couldn't be found in the computer files, what to do if a customer couldn't be found in the files, what happened if an item sold for an amount that differed from the information in the inventory file, what to do with sales taxes, and what to do if the user wanted to leave the program prior to completing a sale recording.

All of these problems required many logical changes in the program—changes that unfortunately resulted in a patchwork. Similar to the World War I biplane held together with bailing wire and chewing gum, the program was more inconsistent than consistent. Finally, in desperation, the entire program was abandoned and started again in the third week. By that time, the company staff was somewhat disillusioned with the whole process of computerizing the sales function.

For the second attempt at the program, a different philosophy was taken. Instead of attempting to write the code directly on the terminal, with only hastily taken notes and a flow, the group read the instructions to Dbase very carefully and used a structured approach. First, the overall design of the program was blocked out. Then each major part of the program was defined. Working from the most general towards the more specific, the program became defined in phases. Finally, the individual line items in the program were written—in the latter part of the third week. With seven-tenths of the work done on paper and only about a third done on the machine, a much more organized and consistent product was created.

At the end of the third week, the system finally was up and running as expected. The goal of the company had been accomplished, but as Dr. Murphy might have forecast, with at least five times the effort and frustration.□ —CH

the best commercially available packaged products. They reason that with a data base it should be a simple process—the computer will do all the hard work. At first glance, that process may seem to be something simple. Unfortunately, to use a data base system is not always as easy as the promotional literature claims. The actual process of setting up the data base may take days, since there are usually many unexpected problems that interfere with what would logically be a simple process. It can be a frustrating experience for those who have never programmed. One quickly learns that the advantages of a DBMS system demand time and effort and are often frustrating.

In selecting a data base system, then, it is critical to know the user's level of sophistication, and to match that with the level of knowledge assumed by the program designers.

Data integrity and security

Data integrity and security are two important issues in the selection of any data base system. It makes no sense to purchase a system that has inadequate safeguards against the inevitable problems caused by equipment failures or curious employees.

Security features are less important in a system using floppy disks since the data can be secured by physically securing the floppy disks in a locked file drawer or cabinet. On the other hand, in a hard disk environment, especially one in which multiple users are accessing the same storage devices, it is imperative that some form of security be implemented. Perhaps the need for data privacy is over-emphasized in smaller firms, but statistics do show that when sensitive information is left unguarded it often ends up in the wrong hands.

Security is generally provided by a sign-on password. Data base systems in general are not very advanced in this sign-on security. Most systems provide only one sign-on to the main system levels, which allows anyone in the system to use someone else's files; all that has been accomplished is to keep unwanted persons from accessing the system. The more critical issue, keeping those on the system out of certain sensitive files also on the system, has not been addressed. There are ways in almost all of the data base systems to implement some sort of user password in the writing of a program. However, a clever, unsophisticated user can still get access to the files.

Data integrity is an altogether different, and far more serious, issue. Unfortunately, many software designers assume that the equipment that their systems will run on will never fail, blackouts will never happen, and back-ups will always be made instantaneously after a critical piece of data has been entered. Real life provides numerous examples of how ridiculous this reasoning is. The average computer system has disk failures and power problems far more commonly than the designers are willing to admit. A crashed file with thousands of dollars of effort invested in its creation is very unpleasant.

What one can accomplish with a $200,000 package running on a mega-mainframe is not about to be found in a $500 package.

A data base system should provide the tools with which to reconstruct a damaged data base. If a bad sector, power-glitch induced write error, or other file disaster occurs, how will the program rescue the user? Most products offer no help. A few products provide users with file re-construction programs that can be of limited benefit. These programs will restructure a file that has been damaged by equipment failure. Generally, this assistance is limited to re-indexing the data base or eliminating the bad-sectored records. That alone makes those products superior to the majority of data base systems.

Multi-user environments

An increasing number of companies are attempting to use a data base system in a multi-user environment. Multi-user systems are immensely more complex than the regular variety and so are data bases that must contend with several users simultaneously. Most systems on the market are really intended only for the single-user system. In a multi-user environment, they may add what is known as record locking, which prevents one user from writing to a record in a file while another user is also using it. A few of the systems are less sophisticated and instead provide what is known as file locking, which locks the entire file while someone else is utilizing it. Most of the designers of these systems have created a pipeline processing system; one user gets served, then another, and so forth. Few systems are really designed to effectively cope in the multi-user environment.

How does a potential user rate the sophistication of a data base? There are no universally accepted guidelines for evaluation, probably because the term means something slightly different to each user, but there are some factors that can be used as a rough guideline.

The method used to search out records is a valid measure of underlying sophistication. The simplest of systems use a physical sequential access or an indexed sequential system. Stripping away all the computer buzzwords, these two methods aren't really data base system methods—they are indicative of a file management program. True data base systems usually use a method like hierarchical, network, or relational organization.

A hierarchical data base organization uses a structure that files data with complex links. A tree organization relates each key element with all related elements in the structure. For example, in a name and address data base, the name New York would only be entered once in the data base. Starting at New York, you would then go to the next branch in the tree, in which you would decide what kind of firm in New York, then perhaps to the name of the person at the firm. The point is that each element links to another element in a logical branching pattern.

For organizing records, another method is known as binary trees, or simply B-trees, a simplified form of the hierarchical data base system. Many products utilize this form of file organization.

When data gets more complex, there's a need for multiple entry points, and some way of accessing the records with more than one key. A network data base organization is simply a form of hierarchical data base system with more than one key or index. Again, in crude forms, these systems are not uncommon in microcomputer software.

Relational data bases

There are many disadvantages to the organization of a data base using either the networking or hierarchical methods. While these two methods offer flexibility and speed, they are limited to only a few variables that can be used to locate files. In real life more variables are sometimes needed. With a relational data base system, records are linked by whatever relational tags are desired. As many keys as fields can be used in some systems. Records can also be accessed any way the user chooses. The most popular data base systems use this relational methodology.

If all this sounds technical and esoteric, the facts of the matter are that data base design *is* a technical and esoteric issue. Far outside the scope of this article theorticians argue about the algorithms used to locate records and the theories of file and record organization; it's one of those fundamental issues that is continually being explored.

From a practical standpoint, a user should look for a system that has the horsepower of a relational system if a multi-key search is required. Not all users will need this sophistication, and after some analysis it may be decided that a simpler file management system is perfectly adequate.

Most data base systems are designed to be used with a relatively few number of files in use at the same time. Dbase, for example, can deal with only two open files concurrently. The concept of an open file is analogous to an open file cabinet. If a file is closed, it must be opened to retrieve or enter records. This step takes time, and if a transaction affects four or five files, and only one can be open at any one time, quite a bit of shuffling will be necessary. Most systems can't handle more than one or two files open at the same time without the file cabinet tipping over, so to speak. Other systems can have as many as 15 files open simultaneously. Obviously, the ability to have several files open at once is only important if the user needs a complex application.

Interconnected with this ability is the capability to update those files concurrently. For example, if an accounting system is on the data base, it would be useful to be able to update the general ledger and accounts receivable files at the same time the sales file for a customer is created. Some systems allow this to be done simultaneously, without a number of program steps to open files, look for records, and update them. The ability of a system to do this without user special programming is a measure of its sophistication.

Conditional searches

Conditional searching is the process of finding a record based upon certain specifications. It may be as simple as searching for a record with a certain value. On the other hand, such a search may be extremely complex and involve multiple fields per record, logical conditions, or even matching of one part of a field with a desired record. Some complex searches might include finding all records for Georgia with a date of account less than 30 days old and a dollar amount of more than $200 or searching for all records of names beginning with FE and with a total of less than 10 characters.

Searching for and finding records is something that every user will do often when using a data base. The capabilities of a system to perform complex searches is crucial to evaluating the abilities of the entire system.

When assessing a data base system, look for several kinds of search capabilities. Find out whether a record can be found if only part of the key is known. For example, if the user is scanning a name and address file for someone with a last name beginning with SM, can the program find all records that contain SM? If it can, then it is a data base system with a wild card or match part capability. Such a system would find the following names: SMith, SMythey SMall, GySMer, FRASMer, PriSM.

Using a system is not always as easy as the ads claim; setting it up may take days.

Obviously, the field must be reduced. A capability to specify that SM are the first letters in the name, not middle or last letters is necessary. Such a system would identify only the SMith, SMythe, and SMall records.

The next level of sophistication enables a user to specify another condition to be met. Suppose that the person being sought lived in Boston, MA. Its a simple matter in some systems to give a command to find all records for which SM are the first letters in the "Name" field and the "City" field is Boston.

The degree to which searches can be made complex is limited only by the imagination of the user. Some exceptionally sophisticated systems allow searches on more than one file at the same time, and conditional logic within that search. The importance of these capabilities depends strictly upon the needs of the user.

The hottest topic in computer software today is interfaceability. Programs like Context MBA and Lotus 1-2-3 have shown that multi-faceted programs with integration of various program functions are desirable features. Some data base programs have the capability of interfacing file structures with other programs, such as WordStar, SuperCalc, or VisiCalc. Most often, this interfacing is done by creating a file that is structured in a readable format for the other program. It does not imply that the other program will be able to dynamically interact with the data base. Unfortunately, many users are disappointed to discover that their data base will only interact periodically and temporarily with another application program.

Most software companies realize that it is not realistic to expect the average user to create a complex application program on the computer system utilizing the data base system. Many of the most popular data base systems, Dbase II in particular, have applications available that link to, or share a common file format with, the data base. This allows the user to have the best of both worlds: the convenience and cost effectiveness of a pre-packaged software product and the flexibility and power of a data base system. Many accounting software programs, such as that from Open Systems, TCS, and Great Plains, includes, or has available, a data base manager as a companion product. This allows the user to create custom reports from the data created by the accounting programs and access it as desired. Some of these products can be used to create ancillary accounting functions, such as time and billing system, which will interact with the software.

A good data base program is one tool that should be a part of a complete micro installation. With the right program, the microcomputer can be used more fully to meet the needs of its users. Choosing the program, however, is a task that requires a keen insight into the needs of the user, and a matching of those needs with the capabilities of the various products on the market.

The accompanying charts are designed to make the selection of a program easier. They are not intended to offer a complete listing of every data base program available. Future issues will include announcements and reviews of other products. □

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Charts begin on page 64

Solving the Data Base Puzzle
Continued from page 63

Chart 1. Company and Configuration Data

PRODUCT	COMPANY NAME AND ADDRESS	OPERATING SYSTEM											MACHINE SPECIFIC?	PRICE	PRODUCT USE			USER INTERACTION			CAPACITY
		IBM PC	CP/M	MP/M	OASIS	APPLE II	APPLE III	CP/M-86	OASIS 16	UNIX	XENIX	UCSD p-SYSTEM			INQUIRY	PROGRAM GENERATOR	BOTH	MENUS	COMMANDS	PROGRAMS	
Quad	Accountants Microsystems 3633 136th Pl. SE Bellevue, WA 98006	•	•	•				•						$695			•	•	•	•	65,535/50/78
Data Base Manager II	Alpha Software Corp. 30 B St. Burlington, MA 01803	•												$295			•	•			32,767/40/60
The Boss	American Planning Corp. 4600 Duke St. Alexandria, VA 22304	•						•						$495			•	•			100,000,000/ 4,000/40
DBase	Applied Software Tech. 170 Knowles Dr. Los Gatos, CA 95030	•				•	•					•		$189			•	•	•	•	2,700/50/20
Versaform		•				•	•					•		$389/495			•	•	•	•	2,060/75/20
Magic Memory	Artaci, Inc. 6547 Satsuma Ave. N. Hollywood, CA 91607				•									$100	•			•			12,000/9/80 char
Friday	Ashton-Tate 10150 W. Jefferson Culver City, CA 90230		•											n/a							n/a
Dbase II			•											n/a							n/a
Reprogrammable Data Base	CMA Micro Computer 55722 Santa Fe Trail Yucca Valley, CA 92284					•								$100	•			•			1,028/32,767/32,767
Manager	Call Manager 1961 Old Middlefield Mountain View, CA 94040	•												$195			•	•	•	•	65,535/50/2,048
File Plan	Chang Laboratories, Inc. 5300 Stevens Creek San Jose, CA 95129	•	•	•				•						$295	•			•			32,000/32/99
Microbase	Compumax Box 7239 Menlo Park, CA 94025		•											$149			•	•			4,000/50/29
Concentric Info Processor	Concentric Data Systems 18 Lyman St. Westboro, MA 08151	•												$395	•			•			65,000/40/50
Condor Data Management System	Condor Computer Corp. 2051 S. State St. Ann Arbor, MI 48104		•	•		•	•	•						$295			•	•		•	65,534/127/127
Data Manager	Datasmith, Inc. Box 8036 Shawnee Mission, KS 66208	•	•											$350	•			•			100,000/32/240
Information Master	High Technology Software Box 60406 Oklahoma City, OK 73146					•								$150	•			•	•		1,000/20/99
The Tool						•								$395		•		•	•	•	15,000,000/255/255
In-Memory Data Base	Howe Software 14 Lexington Rd. New City, NY 10956	•	•											$30	•			•			limited/50/255
Easyfiler	Information Unlimited 2460 Marinship Way Sausalito, CA 94965	•												$400	•			•			60,000/50/1,000
TIM	Innovative Software 9300 N. 110th St. #380 Overland Park, KS 66210		•											n/a							n/a
Data Design	Insoft, Inc. Box 608 Beaverton, OR 97075	•												$225	•			•			32,000/40/79
Data Perfect	LJK Enterprises, Inc. 7852 Big Bend Blvd. St. Louis, MO 63159					•								$130	•			•	•		/32/511
Mag/Base	Mag Software, Inc. 21054 Sherman Way #305 Canoga Park, CA 91303	•	•					•						$295	•			•			999,999/999/50
Mag/Base 2		•	•					•						$495	•			•			999,999/999/50
Mag/Base 3		•	•					•						$795		•	•	•			999,999/999/50

Chart 1. Company and Configuration Data (continued)

PRODUCT	COMPANY NAME AND ADDRESS	OPERATING SYSTEM											MACHINE SPECIFIC?	PRICE	PRODUCT USE			USER INTERACTION			CAPACITY Records/ Fields/ Record Size
		IBM PC	CP/M	MP/M	OASIS	APPLE II	APPLE III	CP/M-86	OASIS 16	UNIX	XENIX	UCSD p-SYSTEM			INQUIRY	PROGRAM GENERATOR	BOTH	MENUS	COMMANDS	PROGRAMS	
IDM-X	Micro Architect, Inc. 6 Great Pines Ave. Burlington, MA 01803		•										PCDOS TRSDOS	$249	•			•			32,767/60/255
Selector	Micro-Ap 7033 Village Parkway #206 Dublin, CA 94568	•	•					•						$450			•	•		•	999,999/89/131
R:Base Series 4000	Microrim, Inc. 1750 112th N.E. Bellevue, WA 98004	•	•										CTOS 795	$495	•			•	•	•	2-511 Unlimited/400/1,500
Sensible Solution	O'Hanlon Computer Sys. 11058 Main St. Bellevue, WA 98004		•	•									TurboDOS	$695							17,000,000/384/256
The Program Generator	Pascal Systems, Inc. 830 Menlo Ave. #109 Menlo Park, CA 94025	•										•	Apple	$295		•		•			32,767/100/60
Personal Pearl	Pearlsoft Box 638 Wilsonville, OR 97070	•	•					•						$295			•	•	•		depends/250/width
Control RDBMS	Phase One Systems 7700 Edgewater Dr. Oakland, CA 94621				•				•					$695			•	•	•	•	65,535/280/510
Idol	Science Management 1011 Route 22 Bridgewater, NJ 08807									•			Thorough-bred	$595	•			•			8,00,000/80/65
The General Manager	Sierra On-Line, Inc. Sierra On-Line Bldg. Coarsegold, CA 93614					•							Franklin 1000	$230			•	•		•	16,777,216/99/40
Detective Inquiry	Software Corp. 1407 Clinton Rd. Jackson, MI 49202					•							Commodore 8032	$180	•			•			no limit/40/1,800
PFS: File & PFS: Report	Software Publishing Corp. 1901 Landings Dr. Mountain View, CA 94043	•				•	•							n/a	•			•			2,200/100/none
IFO	Software Technology for Computers 153 California St. Newton, MA 02178					•								$200			•	•			1,500/20/65
The Creator		•					•						Compaq & Apple	$295			•	•			limited/40/65
Syndex	Sol Software, Inc. 7100 Hayvenhurst Van Nuys, CA 91406												Alpha Micro	$995	•				•		see comments
Analyst	Structured Systems Group 5204 Claremont Ave. Oakland, CA 94618	•	•	•				•						$250			•	•	•		limited/50/132
Personal Data Base	Supersoft, Inc. Box 1628 Champaign, IL 61820	•												$125	•			•			unlimited/20/50
FMS-80	Systems Plus 1921 Rock St. Mountain View, CA 94043		•											n/a							
TCS Simple	TCS Software, Inc. 3209 Fondren Rd. Houston, TX 77063	•	•											varies	•				•		16,777,216/255/255
File/Ides	Threshold Software, Inc. 1832 Tribute Rd. #E Sacramento, CA 95815												HP-86, HP-87	$70	•			•			2,000/20/64
Unify	Unify Corp. Int'l 9570 SW Barbur Blvd. Portland, OR 97129									•	•			varies			•	•			2 billion/256/256
Userbase	Userware Int'l 2235 Meyers Ave. Escondido, CA 92025				•									$1,495			•	•	•	•	32,760/128/1,024
Data Base Manager	Westware, Inc. 2455 SW Ave. Ontario, OR 97914					•							Franklin 1000	$475	•			•			depends/40/25

Chart 2. Program Sophistication

PRODUCT	MAXIMUM KEYS ON A DATA BASE	PROGRAMMING LANGUAGE			SECURITY				DATA INTEGRITY		SEARCHING METHODS						DATA BASE ALTERATION (Without Destroying Data)				MULTI-USER			MAXIMUM FILES IN USE AT ONE TIME
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
Quad	n/a	•			•	•						•			•	•	•	•	•	•	•		•	10
Data Base Manager II	5			•							•					•	•	•	•	•			•	1
The Boss	15		•		•						•					•	•	•	•	•		•		8
QBase	2	•									•		•		•	•	•	•	•	•	•	•		1
Versaform	2	•									•		•		•	•	•	•						1
Magic Memory	n/a		•								•						•	•	•	•			•	1
Friday	n/a																							n/a
Dbase II	n/a																							n/a
Reprogrammable Data Base	3		•				•		•		•						•	•	•	•	•			65,738
Manager	n/a		•							•		•			•	•	•	•		•				3
File Plan	32	•							•	•		•	•			•	•	•	•	•	•			1
Microbase	n/a		•						•				•				•		•					1
Concentric Info Processor	40				•					•				•			•	•	•	•				1
Condor Data Management System	32		•						•	•	•	•	•		•	•	•	•	•	•			•	2
Data Manager	10		•						•			•				•	•	•	•	•			•	3
Information Master	5								•		•					•	•	•	•	•				1
The Tool	1	•	•		•						•						•	•	•	•		•		9
In-Memory Data Base	1		•																					1
Easyfiler	10		•						•		•					•	•	•	•	•			•	1
TIM	n/a																							n/a
Data Design	26			•	•	•			•				•											1
Data Perfect	32			•			•			•	•				•		•	•	•	•				1
Mag/Base	99		•								•		•		•	•	•	•			•			1
Mag/Base 2	99		•								•		•		•	•	•	•			•			5
Mag/Base 3	99		•		•	•					•		•		•	•	•	•			•			20
IDM-X	1			•	•				•															1
Selector	99	•					•		•		•			•	•	•	•	•	•	•	•			7
R:Base Series 4000	400		•		•								•		•		•	•	•	•	•		•	40
Sensible Solution	10	•	•		•	•							•		•	•	•	•	•			•		10
The Program Generator	1			•		•	•	•	•	•	•				•		•	•	•	•			•	16
Personal Pearl		•			•				•				•		•		•		•	•				n/a
Control RDBMS	16		•		•				•		•				•	•	•		•		•			16
Idol	50		•			•	•				•		•		•		•	•	•		•			9
The General Manager	31		•							•	•					•	•	•	•				•	depends
Detective-Inquiry	n/a		•												•								•	n/a
PFS: File & PFS: Report	n/a			•					•		•						•			•				1
IFO	2	•							•	•	•				•	•	•	•	•	•			•	40
The Creator	2	•	•							•	•				•	•	•	•	•	•	•	•		
Syndex	9999	•	•		•	•			•				•				•	•			•			n/a
Analyst	4		•								•						•	•	•				•	1
Personal Data Base	n/a			•																			•	n/a
FMS-80	n/a																							n/a
TCS Simple	16	•	•			•			•	•	•		•										•	1
File/Idea	1			•					•						•	•	•	•	•	•			•	1
Unify	256	•			•	•			•						•	•	•	•	•	•	•			256
Userbase	n/a	•	•		•	•					•			•		•	•	•	•	•	•			n/a
Data Base Manager	depends		•		•						•						•	•	•				•	1

Chart 2. Program Sophistication (continued)

PRODUCT	UPDATING			CONDITIONAL SEARCHING						REPORTS				REPORT FORMATTING										
	W	X	Y	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	RR	SS	TT	UU
Quad			•		•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	
Data Base Manager II		•			•	•		•	•	•	•			•	•	•	•		•		•	•		
The Boss			•	•	•	•		•		•	•	•		•	•		•		•	•	•	•	•	
QBase	•			•	•	•		•	•	•	•	•	•	•	•				•	•	•	•		
Versaform	•			•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Magic Memory	•			•													•		•		•			
Friday																								
Dbase II																								
Reprogrammable Data Base	•	•	•		•	•			•	•	•			•	•	•	•	•	•	•	•	•	•	
Manager		•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
File Plan		•		•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Microbase	•					•		•		•	•		•	•	•		•		•		•	•		
Concentric Info Processor	•			•	•			•	•	•	•			•	•	•	•		•	•	•	•		
Condor Data Management System	•	•		•	•	•		•	•	•	•		•	•	•	•	•	•	•	•	•	•		
Data Manager	•	•		•	•			•	•	•	•			•	•	•	•		•	•	•	•	•	
Information Master	•	•			•			•	•		•		•	•	•		•	•		•			•	
The Tool	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•		•	•	•		
In-Memory Data Base	•			•						•							•				•	•		
Easyfiler	•			•	•	•		•	•		•			•	•	•	•	•	•	•	•	•		
TIM																								
Data Design	•			•	•			•		•	•			•	•		•	•			•	•		
Data Perfect	•	•		•	•		•	•	•	•	•		•	•	•	•	•	•		•	•	•	•	
Mag/Base	•				•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Mag/Base 2		•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Mag/Base 3			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
IDM-X	•	•		•	•			•		•	•			•	•		•	•	•	•	•	•	•	
Selector	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
R:Base Series 4000	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Sensible Solution	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
The Program Generator		•	•		•	•	•	•	•															
Personal Pearl	•			•	•			•		•	•	•		•	•	•	•	•	•	•	•	•		
Control RDBMS	•					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Idol	•				•	•		•		•	•	•		•	•		•		•	•	•			
The General Manager				•	•	•	•	•	•	•	•		•	•	•		•		•		•	•		
Detective-Inquiry				•	•				•				•									•	•	
PFS: File & PFS: Report	•			•	•			•		•	•			•			•		•	•		•		•
IFO	•	•		•	•	•		•	•	•	•		•	•	•	•	•	•	•					
The Creator	•	•		•	•	•		•	•	•	•		•	•	•	•	•	•	•					
Syndex	•			•	•		•			•		•	•	•	•		•	•		•	•	•		
Analyst				•			•	•			•			•	•	•	•			•	•	•		
Personal Data Base	•				•			•			•			•								•		
FMS-80																								
TCS Simple	•			•	•			•	•	•				•						•		•	•	
File/Idea	•			•	•	•		•	•	•					•		•		•			•		
Unify	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	
Userbase	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	
Data Base Manager	•				•			•		•				•	•									

KEY

A = built-in language
B = interface to Basic
C = not available
D = passwords available
E = read-only access to some fields
F = keeps track of who accessed
G = encryption of some data possible
H = recovery program
I = can identify last normally processed transaction
J = indexed sequential
K = binary
L = B-trees
M = chaining
N = relational
O = physical sequence
P = add fields
Q = change field size
R = delete fields
S = reorder fields
T = record-locking automatic
U = record-locking not automatic
V = no record locking
W = update one record at a time
X = multi-record update
Y = multi-file update
AA = one field per record
BB = multi-field per record
CC = nested condition
DD = multi-file search
EE = range search
FF = "wild card" search
GG = on-line definition
HH = pre-defined and stored for execution
II = possible to use multiple data files
JJ = pre-defined queries
KK = user-defined titles
LL = user-defined headings
MM = user-defined footings
NN = user-defined column widths
OO = user-defined text inserts
PP = "sample" prior to running
QQ = multiple subtotals
RR = multiple records across reports
SS = one record per page possible
TT = report time prompts
UU = graphics capability built-in
n/a = information not available

Chart 2. Program Sophistication (continued)

PRODUCT	OTHER PROGRAMS			ANCILLARY PROGRAMS						COMMENTS ABOUT PROGRAM
	W	S	V	G/L	A/R	A/P	IN	GR	WP	
Quad	•				•					All math available in reports. Link to other programs. Color video available on IBM PC.
Data Base Manager II	•		•							Can design form letters. Can directly read & write 1-2-3 worksheet files & Multiplan files.
The Boss										Easy to learn. Advanced capability. Powerful multiuser network.
QBase	•									Automatic checking & automatic filing options to ensure data entry accuracy.
Versaform	•				•	•				Automatic checking and filing options can print on reprinted forms.
Magic Memory										40-70-80 column display. Simple "address-book"-type data base. Sorts, edits & transfers.
Friday										Didn't respond to survey.
Dbase II										Didn't respond to survey.
Reprogrammable Data Base	•						•		•	Source provided.
Manager	•	•	•	•	•		•			A data base mgmt. and applic. development system; fully integrated software text editor.
File Plan	•							•	•	Auto index.
Microbase										On-line help at all times.
Concentric Info Processor	•		•							A visual interface allowing users to do their work directly on the screen as in final report.
Condor Data Management System	•	•	•							Easy to use. No programming experience required. Commands are in plain English.
Data Manager	•									10-key machine language sort with range select and delete.
Information Master	•								•	Performs calculations on fields as well as totals, averaging, counting, and subtotals.
The Tool										Screen generator.
In-Memory Data Base									•	Cassette & disk systems supported.
Easyfiler	•			•	•	•	•		•	
TIM										Didn't respond to survey.
Data Design	•		•							Help screens available at any point in program.
Data Perfect	•								•	May be used with 40 or 80 columns interchangeable. Includes utilities.
Mag/Base	•	•								Upgradeable to Mag/base 2 for growth as user becoms more sophisticated.
Mag/Base 2	•	•								Upgradeable to Mag/base 3. Record locking for multi-user.
Mag/Base 3	•	•								Unique record locking brings multi-user efficiency.
IDM-X	•								•	Fastest key access (1.5 I/D on 25,00 records!). Can sort any field & up to 10 at a time.
Selector	•									Auto-pilot allows user-defined demos, tutorials, and command sequences.
R:Base Series 4000	•									On-line help text. Prompted commands. Data entry verification. Customized menus.
Sensible Solution	•			•	•	•	•			Free form screen editor-data dictionary command files.
The Program Generator										Generates Pascal source code for inquiry, editing, updating TDM Data Base.
Personal Pearl	•	•								Personal Pearl is designed for busines users. Novices may use effectively immediately.
Control RDBMS				•	•	•	•		•	Control provides complete file security and data integrity for multiple users.
Idol				•	•	•	•	•	•	In-depth documentation and menu functions. Programmer hooks into data base.
The General Manager	•								•	Sends reports to standard DOS text files.
Detective-Inquiry	•			•	•	•	•		•	This data base is primarily to store and retrieve in the form of words versus numbers.
PFS: File & PFS: Report	•			•			•	•	•	Very easy to learn and use, yet powerful and versatile enough for numerous applications.
IFO	•	•	•							
The Creator	•	•	•	•	•	•	•	•	•	Features may vary with version.
Syndex				•					•	Capacity: 999,999,999/16,000/16,000. Maxfile: 999,999
Analyst				•	•	•	•		•	Creates customized data entry program.
Personal Data Base										Sorting on up to two fields. Very easy to learn and use.
FMS-80										Didn't respond to survey.
TCS Simple				•	•	•	•		•	Interface to TCS total accounting system data.
File/Idea									•	Interfaces to write/idea word processor, Visicalc, and statistics pacs.
Unify										Offers SQL Query language.
Userbase	•									Record searching is usually done through the use of a hashing algorithm.
Data Base Manager										Does file copy from associated modules tied to the system. Prints labels, reports as defined.

KEY

W = WordStar S = SuperCalc V = VisiCalc G/L = General Ledger A/R = Accounts Receivable A/P = Accounts Payable

IN = Inventory GR = Graphics WP = Word processor • = feature is included

BEST COPY AVAILABLE

Table 1. A ranking of data bases by level of intended user based on manufacturer response to the IA survey

No Reply

Dbase II
FMS-80
Friday
Quad
TIM
Versa File

Advanced

Mag/base-3
The Program Generator TPG
The Tool

Experienced

Reprogrammable Data Base
Analyst
Control P.DBMS
Data Design
Easyfiler
Mag/base 2
O'Hanlon Computer Systems
Quad
Selector
The Boss
Unify

Beginner

Data Base Manager
Data Manager
File/Idea
IDM-X
R:Base Series 4000
Syndex
The General Manager

Novice

Concentric Info Processor
Condor Data Management System
Data Base Manager II
Detective-Inquiry
File Plan
IFO
Idol
Information Master
Mag/base
Magic Memory
Manager
Microbase
PFS:File & PFS:Report
Personal Data Base
Personal Pearl
QBase
TCS Simple
The Creator
Userbase
Versaform
In-Memory Data Base
Data Perfect

Table 2. CP/M compatible data base programs

Analyst
Condor Data Management System
Dbase II
Data Manager
FMS-80
File Plan
Friday
IDM-X
In-Memory Data Base
Mag/base
Mag/base 2
Mag/base 3
Microbase
O'Hanlon Computer Systems
Personal Pearl
Quad
R:Base Series 4000
Selector
TCS Simple
TIM

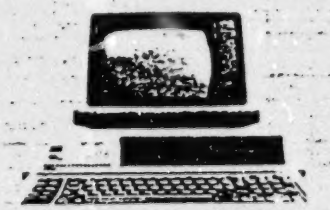
Table 3. MSDOS and IBM PC compatible data base programs

Analyst
The Boss
Concentric Info Processor
The Creator
Data Base Manager II
Data Design
Data Manager
Easyfiler
File Plan
In-Memory Data Base
Mag/base
Mag/base 2
Mag/base 3
Manager
PFS:File & PFS:Report
Personal Data Base
Personal Pearl
The Program Generator TPG
QBase
Quad
R:Base Series 4000
Selector
TCS Simple
Versaform

COMPUTER BOOKBASE

Que On Systems

IBM's PERSONAL COMPUTER



IBM's Personal Computer
Chris DeVoney and Richard Summe
This book describes IBM's personal computer and interprets its design and business significance for readers with various backgrounds. Programmers will find an extensive description of the system, languages, business, and educational software, as well as commentary about IBM's official posture of working with outside programmers. For potential users, there is a discussion of the system in both absolute and comparative terms.

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PROJECT MANAGEMENT

Project management differs from company management in that it is specific to one project or more. The size of a project can vary greatly, however, according to definition. Without successful project management, the future of the firm is in jeopardy.

There are several types of software applications associated with project management, especially:

project scheduling,

estimating and bidding,

project management and job costing,

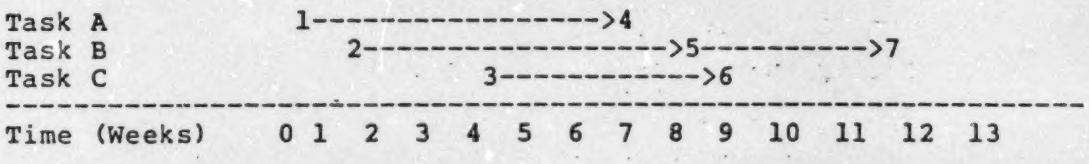
inventory control, and

project accounting.

Inventory control and accounting have been discussed in Section 3 and receive less attention here.

Project Scheduling

Scheduling can be as simple as cross referencing personnel time allocated per task or module with real time. To complicate it materials delivery and use can be added. The three most common forms of project scheduling tools are the Gantt-Milestone bar chart, the critical path method (CPM) chart and the Program Evaluation and Review Technique (PERT) chart. The Gantt chart consists essentiallly of a time scale along which are located various significant completeded assignments (milestones) associated with a particular task or component. While useful, it does not display the interrelationships existing among the milestones. There is no indication that work needed to achieve milestone 4 of Task A stems directly from milestone 2 of Task B and that other necessary tasks connect milestone 4 to milestone 7.



The CPM links the milestones or events into a network which traces the development of the project with the most time consuming (longest) path of activities from the beginning to the end of the network being the critical path.

CPM is a part of the Program Evaluation and Review Technique (PERT) and concerns itself with the longest path to completion. PERT is concerned with the entire network of activities and

events, how they are organized and the calculation of the length of time it will take to move from one event to another. This scheduling permits the planner and manager to rework construction schedules to eliminate slack, to plan for the ordering of materials and to compute planned versus actual completion of events (milestones). Done on paper, CPM and PERT are cumbersome because there is regular recalculation of the networks and the time intervals between events. However, with a computer this can be easier and comparisons make between alternative charts (schedules).

There are several project scheduling packages on the market and are listed here. One, the Harvard Project Manager, has received a supportive review in the April 2, 1984 issue of **InfoWorld**. It combines CPM and PERT, is said to have a good cursor positioning method and uses windows to describe the elements in your chart. It runs on PC-DOS and MS-DOS, requires 128K RAM; two disk drives and a dot matrix printer with a graphics option. It retails for about $395.

Product Information - Project Scheduling

CPM and PERT scheduling
The Harvard Project Manager
Harvard Software Inc.
521 Great Rd.
Littleton, MA 01460 617/486-8431
Runs on: PC-DOS and MS-DOS

CPM scheduling and Resource Leveling
Data Trek
PO Box 5081
Ft. Wayne, IN 46895 800 227-3800 x470
Runs on: TRS-80 all models, Apple, IBM PC

CPM - Project Management
North American MICA, Inc.
11772 Sorento Valley Rd.
San Diego,Ca 92121 619/481-6998
Runs on: CP/M and CP/M 86

Network based planning
PMS 80
Pinnell Engineering Co.
5331 SE McAdam Ave., Suite 270
Portland, OR. 97201
Runs on: CP/M

PERT and Shortest Path
Decision Science Software
865 Castle Ridge Rd.
Austin, TX 78746 512/327-1463
Runs on: Apple, TRS-80,, IBM-PC, HP-125

PMS-II
North America MICA Inc.
11772 Sorrento Way Rd.
San Diego, CA 92121 619/481-6998
Runs on: CP/M, CP/M-86

Project Management
Peachtree Software Inc
3445 Peachtress Rd. NE
Atlanta, GA 30326 404/239-3000
Runs on: CP/M

Estimating and Bidding

Estimating and bidding is a cross between a hard nosed itemizing of costs and an art form where contingencies like weather and changes in materials costs are anticipated or factored into the bid. The nature and complexity of your bidding procedure are largely a function of the nature of your service and your size.

A spread sheet or integrated data base management package will be quite adequate for estimating small building, renovation and construction jobs. As with any estimating program, the first several times will be somewhat cumbersome and time consuming because you are learning the system and building the data base. Therefore, choose a more slack period for your initial ventures.

There are several estimating programs on the market. They are ususally written in BASIC and may be rigid or flexible to your needs depending on the cost and complexity of the program.

Product Information - Project Estimating

Estimator and Framing Calculator
Mendocino Software Inc.
PO Box 1564
Willits, CA. 95490 707/459-6583
Runs on: CP/M and Radio Shack

Estimating, Accounting, Job Costing and Payroll
Esccomate
4412 S. 89th St.
Omaha, NE. 68127 402/331-8250
Runs on: IBM PC and Radio Shack

Estimating and Accounting
Constructive Computing
PO Box 2066
Kansas City, KS 66110 913/596-2113
Runs on: MS-DOS

Planning and Estimating
William May
901 N. Calvert St.
Baltimore, MD 21202 301/752-1554
Runs on: Apple II plus

Project Management and job costing are essentially the recording and comparing of estimated figures (bids) with the actual figures (costs). Based on these planned versus actual costs, steps are taken to maintain course, speed up the project, tighten or reduce labor costs, etc. The advantange of the microcomputer is that the data can be made readily available on an unofficial basis as needed rather than waiting for quarterly or monthly posting.

We noted that job costing can be a module in an accounting system. It can also be a stand alone module. Examples of stand alone packages on the market are:

Project Management
Micro Associates Inc
2300 Hwy 365, LB 131
Nederland, TX 77627 713/724-6583
Runs on: TRS-80, Apple, Victor, Zenith, Xerox

Job Cost System
Computer Systems Design Inc.
PO Box 735
Yakima, WA 98907 509/575-0320
Runs on: IBM PC, TRS-80

Job Costing
D.B. Software Co.
11840 N.E. Brazee
Portland, OR 97220 503/255-7735
Runs on: TRS-80

Job Costing
Micro Business Consulting
415 N. Akers Rd, Sp.76
Visalia, CA 93291 209/625-4597
Runs on: TRS-80, others

Project Management/Job Cost
Viehmann Corp.
274 Main St.
Reading, MA 01867 617/944-5787
Runs on: CP/M, MP/M

Job Cost System
Automatic Consultants
610 Santa Cruz Ave., #204
Menlo Park, CA. 94025
Runs on: IBM-PC, CP/M

Job Cost System
Scripps Data Systems
9747 Businesspak Ave., #202G
San Diego, CA. 92131
Runs on: IBM-PC

Job Cost
Open Systems Inc
430 Oak Grove
Minneapolis, MN 55403
CP/M, CP/M-86, PC-DOS

Contingency Planning

Contingency planning is especially useful at the project management level. By maintaining a budget and comparing the actual costs by component to the planned costs and timetable, the manager has a good fix on whether the project is coming in on time and within budget. If this planned versus actual budgeting is on a microcomputer, you can also play "what if" games by changing variable costs to see how the results change the entire project. The spread sheet or integrated data management package is very useful for this.

Since resources are often balanced among several projects, contingency planning is especially useful. In other words, some projects are more profitable than others. However, there is a competition for time and personnel between them and playing "what if" games gives the user a better idea of the possible budgetary ramifications when resources are shifted or maximized on one project, possibly at the expense of others. If your job costing software can be integrated with spread sheet software, some time could be saved in contingency planning.

Project Communications

Communications hardware and software allows computers to interact via cables or phone lines. For larger construction firms or firms that have projects operating a long way from the company headquarters, there is good reason to consider using a microcomputer at the job site to communicate with headquarters. This can be done via a portable computer and transfer the data via either phone lines or delivery of the disk/tape. In either case the matter of compatability is crucial.

The microcomputer floppy disk drives are sensitive to dirt, smoke and sawdust so the work station should be kept clean and free of airborne contaminates. In this case the fixed hard disk or rigid disk cartridge are worth considering.

Linking computers in a company via a local area network (LAN) or linking work stations to a multer-user microcomputer are important matters to consider when buying a micro but less important in project management.

The inter-personal project communications are a different matter. The availability of regular print outs on project status are an extremely useful tool in project management, planning and communications. Regular weekly or bi-monthly status reports shared with senior project persons can add important feedback and flexibility to project management.

CCAN CONSTRUCTION COMPUTER APPLICATIONS NEWSLETTER

August, 1984 Volume IV, Number

CONTENTS

Publisher's Corner.....1
New Products.....1
PC Corner.....2
Tip Of The Month.....2
Voice Mailboxing Developments.....3
IBM Users Group Activities.....3
The Micro-Mainframe Connection.....4
Computer User Profiles.....4
Software Review - Bid-Rite Estimating.5
Software Review - 2001 Accounting.....6
Software Review - CACTES Estimating...7
Upcoming Events.....8

PUBLISHER'S CORNER

This week while preparing for a vacation in Maine, I kept wishing I had a Hewlett-Packard 110 Portable computer to take with me. It's not that I want or expect to do any work on my vacation, but it would be handy to have in case I decide to do some writing or come up with some ideas to try out. The HP 110 has Lotus 1-2-3 built in and can also run dBASE II, which would allow me to do some business strategy work and dBASE II programming, and perhaps just catch up on designing a couple of reports.

The more I think about it, the more I'm convinced that computers such as the HP 110, and an IBM version that's sure to be produced sooner or later, will replace both the desktop computer and the handheld calculator for many in the construction industry. It is ideal for those individuals who are only using these devices for Lotus and some memo writing anyway. The desktops will remain in the bookeeping departments, on secretaries' desks and on the desks of those individuals who can afford both a desk computer and a portable.

The Third Law of Portability, according to Andrew Fluegelman, Editor-In-Chief of PC World:

A computer will be put to use in proportion to its transportability.

NEW PRODUCTS

Project Management System

Metier Management Systems has introduced ARTEMIS-AT, a project management system designed specifically for medium-sized construction firms. Applications include cost control, planning and scheduling, timesheet and personnel management, and financial accounting, all of which are fully integrated. Metier provides installation, software support, hardware maintenance, documentation, training, and access to telephone assistance. Contact: Metier Management Systems, 7310 Alton Way, Suite L, Englewood, CO 80112.

Turnkey Job Cost System

Robco Data Systems and Keymark Systems are teaming up to offer turnkey systems to the construction industry. The newly-available Job Cost System can be used as a stand alone module or integrated with the Payroll, Accounts Payable, and General Ledger modules. Job cost can be used to track specific costs, estimates, billings, and receipts by job, job phase, or sub-phase. Contact: Robco Data Systems Inc., 7790 Mossy Cup, Boise, ID 83709; (208) 362-3773.

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WEXPRO Construction Management

Construction Systems & Software Co., a division of Wexco International, has released the **WEXPRO Construction Management & Project Control System** for the Wang 2200 series. The system will be available for the Wang PC later this month and the mass microcomputer market later this year. The system combines CPM scheduling and graphics technology to provide a multi-year variable calendar, automated duplication of activities and connectors, and on-screen editing. Time, cost, and resource modules are included. The resource module allows discontinuous resource scheduling. The user can build and title reports and catalog them for further use. Contact: Wexco International Corp., 506 Santa Monica Blvd., Santa Monica, CA 90401; (213) 458-1861.

Residential Electric Estimating

The Edge is an estimating program for residential electrical wiring designed by an electrical contractor for Apple computers with 48K memory. An IBM PC version is planned. The program generates rough-in and trim material costs, labor costs, travel allowances, and material lists. It factors in mark-ups and prepares custom proposals for each job. Variable cost comparisons and comparisons of actual versus estimated job costs are additional features of the program. The unit price is $285. Contact: Cal-Namar, P.O. Box 149, San Luis Obispo, CA 93406; (805) 544-1077.

UNIX-based Estimating System

Constech Inc. has introduced the MICOS **Construction Cost Estimating System**, a UNIX-based system for microcomputers. The system includes both hardware and software and utilizes the ORR System, a 19,000-item construction cost data base available through timesharing. MICOS can be integrated with accounting, word processing, spreadsheet, graphics, design, specifications, investment analysis, scheduling, and project management software for a complete construction management system. The hardware consists of either a Plexus or Altos mulituser system with a minumum of 512K memory and 40M disk storage. Among the programs availalble on the system are Invest, Optimum, Goal, Masterspec, Plantrac, and PCM. Contact: Constech Inc., P.O. Box 610663, DFW Airport, TX 75261-0663; (214) 257-1168.

Correction

J & L Bidware informed us that they sent us incorrect information last month and asked us to run a corrected price. The cost for the IBM PC version of their Bid Estimation System (BESt) is $695, and the Apple IIe version is now $395. Contact the company at (402) 643-3939.

PC CORNER

Hewlett-Packard has just released a new 9-pound portable computer, the HP 110. It measures 13 by 10 by 3 inches and has a liquid crystal display of 16 lines by 80 characters. The price is $2,995. One of its options is an IBM PC interface card and software, which should enable the HP 110 to communicate with the PC. Other features are a built-in modem, 272K memory, and rechargeable 20-hour battery power source. MS-DOS 2.01, Personal Applications Manager, Lotus 1-2-3, Memomaker word processing, and terminal and communications software are included in the price.

TIP OF THE MONTH

Make Sure Your Computer System Contract Really Protects You

A buyer of computer systems or services should not sign the vendor's standard contract without determining whether it includes certain important protections.

A contract should specify all parties involved, what is to be done, who is responsible for doing what, a performance timetable, the expected level of quality, performance criteria, acceptance criteria,

the link between performance and payment, warranties, ownership rights, and remedies in cases of non-performance.

It is a good idea to make sure that vendor limitations on where the equipment may be used do not rule out any new location to which your offices may be moved. Also check to determine that the vendor bears responsibility for any damage or loss to equipment during shipping.

As long as these basic protections are included, it is neither necessary nor useful to negotiate for everything you can get, as many vendors are learning that some customers are not worth having if they cut too deeply into profits. Decide which items are absolutely critical to you and don't make a deal without them. Most vendors will not agree to remedies beyond refund of the purchase price if the system fails to operate and business is lost as a result. This risk can be more easily covered by business interruption insurance.

VOICE MAILBOXING DEVELOPMENTS

Electronic Mail & Micro Systems (EMMS), of 6 Prowitt St., Norwalk, CT 06855, devoted much of its May 1, 1984 issue to developments in voice mailboxing as the wave of the future.

Voice mailboxing was invented by Gordon Matthews and has been on the market since late 1980 when it was first offered by VMX of Richardson, Texas. The concept involves automated telephone answering and message notification. A caller can leave a long, detailed, or confidential message which will be accessible to the voice mailbox recipient at any hour and from any pushbutton telephone. EMMS reports that voice mail costs $7 to $20 per user-month, as compared to $40 for an answering service or $100 for a group secretary.

The earliest voice mail systems required more than 1,000 users and cost at least $300,000, restricting the potential users to large companies. Today, Octel Communications Corp. of Santa Monica, California offers Aspen, a system that supports 100 users for $55,000 and can be expanded to 1,500 users for $135,000.

An important new development is the ability to integrate a voice mail system with an existing PBX system at a relatively low cost of $100 to $250 per user. Previous voice mail systems were only operable by registered users or by calling the system itself, but when integrated with a PBX system, they can be accessed by all PBX telephones.

Possible uses of voice mail systems include interdepartmental communications, communications between field employees and the home office, or increasing the productivity of office staff by sparing them from the constant interruptions of the telephone.

IBM USERS GROUP ACTIVITIES

In 1983, the Construction Project was organized within COMMON, a group for users of IBM computers. The Construction Project has submitted a set of 70 resolutions to IBM calling for a variety of improvements and modifications to their construction-related products such as CMAS (Construction Management and Accounting System). IBM has been working with COMMON within the range of authorized responses to user requests.

The 70 resolutions cover such CMAS features as: changes to file and record lengths, adding holiday routines for weekend days, adding categories to payroll and subcontractor records, modifying report formats, publication of state tax tables, updating of job cost records when invoices are adjusted, adding the ability to change defaults on all screens, ability to select time frames on job histories, elimination of the need to have a dedicated file reorganization system, and adding the ability to run multiple copies of management reports with a simple command.

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The following proposed modifications to CMAS have received a positive response from IBM and are either available or about to be made available on the System 34 and System 36 computers:

- A vendor analysis reset with quantity-to-date and year-to-date
- Calculation of state unemployment taxes for multiple companies
- Capacity to track employer-paid FICA for more than 1,000 employees
- Data dictionary retrieval
- Equal opportunity reports

Of the remaining proposals, only six have been rejected for consideration by IBM for a variety of reasons. The bulk of the items are either under study or recognized as valid requests meriting further development.

For more information on the construction user requests and IBM's response. contact Bob Houlihan, Sambol Construction Corp., 1033 N. Maple Ave., Toms River, NJ 08753.

THE MICRO-MAINFRAME CONNECTION

The ability to link an employee's microcomputer to the company mainframe is not something to be taken for granted. Frustrated microcomputer users and their employers feel that it should be a simple matter for the data processing department to figure out, if only they were competent. However, many people do not realize that the necessary technology for communication linkages and file format adaptors has not yet been sufficiently refined.

Among the approaches now being used are terminal emulation packages and asynchronous or bisynchronous terminal controllers. These methods are generally viewed as slow and awkward, although some argue that high speed is not a usual requirement of the micro user. Speed is an issue however, if you're trying to use a modem to send information from a jobsite micro to an office mainframe located a long-distance phone call away.

Several software packages for micro-mainframe linkages are being tested and some positive results have been reported. A piece of communication interface hardware is also being developed but the results have been disappointing to some. CCAN will attempt to keep you posted on anything really promising.

COMPUTER USER PROFILES

R. R. Gregory Corp., Waldorf, Maryland

In November 1983 CCAN interviewed company president Ron Gregory about his recent decision to purchase a Cado Cat III. The general contracting firm, which works primarily on Federal projects, employs 5 people in the office and about 10 in the field and works on an average of 8 projects annually. This month, we contacted the company to find out how they are progressing as new users.

The Cado Cat, a minicomputer, was purchased with 2 remote terminals and Cado software. The initial cost was $22,000 and the terminals were added for $3,500.

Applications include payroll, accounts payable and receivable, and job costing. In addition, a list of vendors and subcontractors is maintained so that they can be selected and notified of current bids. Most of the office employees have occasion to make use of the computer system during the course of their work.

The job cost program was customized to company needs, so there have been a few bugs in the system, but nothing serious, according to Mr. Gregory. He is basically satisfied with the system, though he reports it has been frustrating at times, as he expected. It took about 6 months to train people and get the system running smoothly. The time to train the staff had to be fit into the schedule without disrupting business.

Mr. Gregory states that at this point, the computer has not saved the company any time or money. He expects that for the first year it will cost money and consume a lot of time.

However, automation has given them better control over information and provided more and better information in less time and with more accuracy.

Blount Construction Co., Atlanta, Georgia

Richard Lord, vice president, discussed how Blount Construction makes use of an IBM System 34, an IBM PC, and a Compaq. The company does highway construction, paving, and site development. Its staff includes 15 office personnel and 85 field employees who work on approximately 150 jobs a year.

The System 34, which cost $60,000, including re-programming of its CMAS package, was purchased 5 years ago. It is used for all bookkeeping, general ledger, payroll, and cost accounting. CMAS has been supplemented with an equipment program to keep track of the company's nearly 100 pieces of equipment. The business spends more on equipment than on materials in this line of work.

The PC and the Compaq, used only by Mr. Lord and a secretary, cost about $3,000 apiece and were purchased in late 1983 and early 1984 respectively. The PC is used for job recap because he didn't like the way it was handled by the S/34. He uses the Lotus 1-2-3 spreadsheet program to recap and graph unit costs, to forecast costs, and to estimate paving jobs. The Compaq was purchased along with an extra monitor strictly so he could take it home and work 24 hours a day! It may be used on-site in the future.

Mr. Lord reports that Lotus is "the best thing since sliced bread". He has no programming background but found it easy to use. He now uses Lotus to keep schedules and prices, make updates, and track labor and equipment histories. In choosing to buy the IBM PC, he first decided he wanted Lotus. Then he looked at systems that could run Lotus and selected the PC because it could interface with the S/34.

The IBM PC has not yet saved the company any time or money, something that he imagines will take awhile. One influence of automation has been that field reporting procedures have been changed to the required format for getting information into the system.

Mr. Lord has learned the hard way to be careful when changing disks. He lost some data by not observing the proper procedures for removing a disk and placing a different one in the disk drive. He has also been amazed at how much storage space has been needed and plans to get a hard disk drive in the near future. The purchase of a letter quality printer is also planned.

BID-RITE ESTIMATING

System Requirements: IBM-PC (or Compatible)
Language: BASIC

At the Softcon Software show in New Orleans last February we learned of several construction applications from a Canadian firm, Businessworld Inc. These include estimating, job cost, and tool control systems for PC and PC Compatibles using MS/DOS as well as the Kaypro and other CP/M-based computers.

The Bid-Rite Contractor Estimating System is a quantity take-off and estimating system for general, electrical or mechanical contractors. The system includes a high speed counting and measuring probe which connects to the computer via an interface card that is inserted into one of the PC's expansion slots. The estimator can set the scale.

The probe also serves as a marker to indicate which items have been taken off. With the probe or with the keyboard, the estimator can measure dimensions directly off the plans, have them converted to area or volume, then automatically multiplied by the unit labor and material prices to produce the estimate. During take-off, Bid-Rite prints out a log of all take-off items.

Bid-Rite allows users to maintain a price book they can set up themselves or they may purchase a national or regional price book

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with update sevice on diskette. Currently available price books include the Moore Plumbing Book and the NPS Electrical book with other books on the way. Prices may be obtained by part code, scrolling or by a decision-tree screen search. The system also allows the user to build assemblies and define crews. Crew makeups may also be searched by scrolling.

Other features of the estimating program include job difficulty factors, checklists for overhead items, demo data on the diskette, automatic recovery after power interruption, automatic set-up of job-cost system and an optional Bid-Analyzer feature.

The Bid-Analyzer allows the estimator to list competitve quotes and select which quote to use or automatically incorporate the lowest quote into the final estimate. The cost of the Bid-Rite estimating system, including the measurement probe, is $2,695. Bid-Analyzer is $595.

On-Track Job Cost System

The On-Track Job Cost System can be used as a stand-alone or integrated with other accounting functions. Features of the job cost system include flexible work breakdown structure, audit trail, and committed material values from an outstanding purchase order file. The Job Cost system is $1,495. For a nominal extra cost, the developer will set up ASCII interfaces to the user's accounting system.

For more information contact Businessworld's U.S. representative, Mandat Infotech Marketing, P.O. Box 2613, Redmond, WA 98073.

2001 FINANCIAL ACCOUNTING & JOB COST

System Requirements:	IBM-PC and Compatibles
Language:	BASIC

Another system seen at the Softcon show that is starting to be marketed to the construction industry is 2001 software by Financial Information Systems (FIS) of Richardson, Texas. The system will run on floppy or hard disk, and features such amenities as built-in tutorial, automatic posting, 40-column screen display for easy reading, and use of function keys for menu selection.

The FIS system incorporates a proprietary coprocessor with 64K of memory that is added to one of the extra expansion slots in the computer. This coprocessor allows 2001 to update multiple files quite quickly and work with larger files. (FIS claims that 2001 will calculate a 55 person payroll in 9 minutes.)

Payroll features multi-state capability but if an employee works two or more states in one day, two checks must be generated. Payroll posts gross pay to job costs. All other payroll costs must be put into company overhead. However, you can pay an employee one amount and charge the job at the same or different rates. Overtime (time and a half) may be entered, and the default rates may be overridden manually. The system does not do a table look-up for wage rates based on classification or craft.

Other unique features of 2001 include:

1) The ability to pull material out of inventory and charge it to a job (for service and maintenance contractors);

2) Tracking of earnings billed vs. received, including amount to be billed based on percentage of completion;

3) Ability to transfer data into 2001's proprietary data base management system, which can then be use to create custom reports. such as productivity reports using job cost information.

Note, job cost tracks labor hours and dollars, equipment hours and dollars, and material quantity and dollars. Subcontracts are not handled separately but must be treated as a labor item. FIS says that a future revision to job cost will treat subcontracts separately.

The 2001 system should be suitable for small contractors not requiring features normally found in sophisticated payroll or job cost systems.

The cost of the basic system, which includes accounts payable, accounts receivable, invoicing, general ledger, and payroll, the coprocessor and 90-days toll-free support is $3,795. The job cost system is an additional $595. Installation and training is done through the tutorials provided with the system. For more information contact FIS, 411 Industrial Drive, Suite 107, Richardson, TX; (800) 527-4681.

CACTES - SOPHISTICATED ESTIMATING FOR MEDIUM AND LARGE SIZED CONTRACTORS

System Requirements:	WANG 2200, IBM-36
Language:	BASIC

Computer-Aided Construction Take-off & Estimating System (CACTES) was first developed in 1976 for the WANG 2200 series of minicomputers. It has since evolved into a very sophisticated program offering such features as question/answer estimating, complex assemblies, construction of crews and multiple-user simultaneous take-off. It will also be available this fall on the IBM 36.

The CACTES data base is set up by the user into Cost Items and Phases. Cost items contain resource data to calculate and price an item while Phases are groups of cost items, much like work packages or assemblies in other estimating systems. In addition, the user can add questions for the estimator to answer during take-off, allowing the estimator to select appropriate options or be reminded of other considerations.

Typically, the data base is set up to correspond to a numbering scheme such as AIA/CSI. In addition to the item-phase-division coding system, group codes can be added to each takeoff item to correspond to an outside numbering scheme as required by the owner.

Each cost item has a unit of measure, a 54-character description, a unit price for labor, material, equipment and subcontract, and a set of factors. The factors include a measurement conversion factor, 2 formula factors for establishing relationships between dimension and final quantity, a pass-through formula for calculations that may affect other items, such as a void factor and a miscellaneous factor. These formula factors can be totally defined by the user without programming knowledge. The factor capability can also be used for table look-ups and for comparison statements to determine calculations that will be made depending on certain values, such as additional requirements that might be needed as depth of excavation increases.

CACTES allows the user to store the quotes for material and sub prices, as well as a flag if the price is subject to escalation. The labor composition of cost items can be built and stored in the computer, and productivity factors calculated or entered manually. Equipment expendable items can be assigned to each piece of equipment to help compute fuel requirements and repair costs for the equipment spread on each project.

The Take-Off

The estimator may take off individual items or phases by specifying the cost code or phase number and inputting the quantity or dimension requested by the computer. If the cost code is not known and the user does not want to look it up in a book, the user may open up a window on the screen and locate the item by specifications. The user can then scroll through the various choices until the specific item is found.

In addition to the take-off data, the estimator may enter notes relating to the item taken off. Such notes might be reminders to modify a crew configuration or to look up certain data or other items to be taken off on another drawing. As many lines of notes as needed may be entered and can be recalled at will.

Other features of the take-off process include:

- the ability to override default values in the file, change how a calculation is made for subsequent or previous take-offs, and change or modify quantities before they are calculated

- a calculator mode for entering a value as a result of an on-the-spot calculation from the keyboard and a detailed log of all entries. Additionally, sub-assemblies can be built and reused during the take-off process.

The effect of all these features is to give the estimator the same degree of flexibility that he/she would have with pencil and paper. It even flags items with modified values or specifications.

Reports

CACTES offers a wide variety of reports, including estimate summaries, a labor craft/class report (detailing specific manhours and cost for each cost item by craft and class of labor), equipment summary, unit price lists, and unit price developments. Using a report generator facility, the user can customize his own reports. There are also six levels of sorting and seven levels of subtotals available. The user may apply division-level or job section-level factors to any of the five resource categories by a percentge or by dollars per hour. The flexibility helps produce different reports for different sections of the projects or for alternate bids.

Summary

CACTES is a serious product to consider for the medium and large-size contractor with a full time estimating staff. General and heavy contractors should be especially pleased with the system's ability to set up crews and estimate equipment costs. CACTES offers multiple-user capability with built-in security and access provision.

In addition to building its own database, the Richardson data base may be purchased. Other data bases created by current CACTES users will be available in the future. Interfaces are available to carry estimate costs over to budget items in the user's job cost system. Other programs available include a Bid Solicitation system. Bid Day system, job cost, and financial accounting software.

The CACTES software ranges from $10,000 to $32,000. For more information contact E. F. Paynter & Associates Inc., 6508 Westfield Boulevard, Indianapolis, IN 46220; (317) 257-7561.

UPCOMING EVENTS

CKPA 1984 Fall Conference on computer aided design and drafting and other computer applications in construction will be held October 15-17 in Charlotte, NC. Sponsored by: Society for Computer Applications in Engineering, Planning, and Architecture, Inc., 358 Hungerford Dr., Rockville, MD 20850; (301) 762-6070.

Software for Project Management and Estimating will be held in Los Angeles on September 20-21 and Washington. DC on October 11-12, 1984. This seminar provides an in-depth examination of what a computer can do to meet a contractor's project management and estimating needs. Features of popular software packages will be reviewed. Sponsored by: CIP Information Services, 1105-F Spring St., Silver Spring, MD 20910; (301) 589-7933.

Also offered by CIP Information Services is **Computers in Construction**, in Atlanta, October 25-26. This comprehensive seminar is designed to assist contractors in the selection and utilization of computer systems and software. The course reviews the equipment and programs available to computerize accounting, estimating, job costing, equipment control, materials inventory, scheduling, and word processing. It is offered periodically in various locations throughout the U.S.

Hundreds of computer programs are now available to improve the efficiency and bottom line of construction businesses.

Here's the only source you need to review them all . . . and decide which ones are right for you!

CONSTRUCTION COMPUTER APPLICATIONS DIRECTORY

Almost all of the tedious paperwork requirements of the construction industry can now be handled quickly and accurately by highly-specialized computer programs.

This includes specific construction functions such as estimating, scheduling, surveying and integrated job costing.

The programs are available and the bugs have been worked out. Yet many construction professionals hesitate to make use of them simply because they have never learned how to use computers.

The *Construction Computer Applications Directory* was developed expressly for the construction professional who wants to tap the countless benefits of modern construction software without actually getting bogged down in computer technicalities.

It provides a comprehensive, systematic overview of the hundreds of computer programs that savvy construction professionals are now using to improve efficiency and increase profits. Non-technical and fully indexed and cross-referenced, the *Directory* helps you locate the proper software to handle your needs.

The table of contents at right shows how thoroughly we planned the *Directory* in order to help you locate, select and use the kind of computer programs that will help you gain much greater control over *every* job.

Check the postpaid certificate below to see the terms of our no-risk trial examination policy . . . and then return it today to receive your copy of the only book that's been specifically designed to help you improve your business through state-of-the-art computer technology.

CONSTRUCTION COMPUTER APPLICATIONS DIRECTORY

Table of Contents

I. Introduction
II. How to use this Directory
III. Index by Applications
  A. Financial Accounting, includes:
    1. Payroll
    2. Job Cost Accounting
    3. General Ledger
    4. Accounts Payable
    5. Accounts Receivable
    6. Inventory
    7. Purchase Order Control
    8. Equipment Costing
  B. Scheduling & Project Management
    1. CPM & PERT Scheduling
    2. Contract Management & Administration
  C. Estimating and Job Acquisition
  D. Surveying & Engineering
  E. Graphics
  F. Data Management
  G. Word Processing
  H. Electronic Spread Sheets, Financial Analysis and Modeling
IV. Index by Computer Operating System
V. Index by Type of Contractor
VI. Detailed Listings by Vendors
VII. Glossary
VIII. Publications and Information Resources

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PRACTICALC™ PROGRAMS

The PRACTICALC™ software is a series of computer-aided estimating and cost control programs, designed to flex and mold to the personal pattern of an estimator. The software accelerates the manual estimating technique, cutting the information gathering "grunt work" time to a fraction of that required in the totally manual method. The software, while controlled by the estimator, is designed to reduce the chance of error resulting from omission or mathematical miscalculation.

The PRACTICALC™ programs are not "systems" in themselves, but rather stand-alone software packages, designed to enable an estimator to develop definitive estimates efficiently and accurately. This software has been designed to operate on IBM P/C Apple (II, II plus & IIe), Kaypro, and Epson QX-10.

BID ANALYSIS & SUMMARY

The Automatic Bid Revision Program enables a contractor to effortlessly cope with the error prone and ulcer producing process of final bid revisions. Automatic Bid Revision will calculate base bid amounts accurately and instantly and process a summary. As modifications are required, the program software will accommodate changes and will recalculate combination bids up to three variables. You can handle your "cut session" with ease, speed and accuracy right up to the last minute. Automatic Bid Revision requires minimal training and generates high dollar returns.

HOME BUILDERS ESTIMATING PROGRAM

This program is designed to take off and price material and labor costs for a complete production or custom home. The program will develop an estimate for site preparation, concrete, rough and finish carpentry, millwork, drywall, insulation, siding, roofing, electrical, mechanical, and miscellaneous costs. Material and labor costs are summarized simply in a fraction of the time required for manual method.

CONCRETE ESTIMATING PROGRAM

The Concrete Estimating Program is designed to aid concrete estimators (sub or general contractors) in the preparation of their competitive bids. The software focuses on aiding the estimator in take-off and pricing...not doing it for him with shortcuts and average prices. The program will not override your personal perogatives. The classes of work include quantity of concrete, formwork, pans, finishing, rubbing and patching, grading, curing and accessories. The program is intended to be used for cast in place concrete for all commercial building structures, from the smallest corner grocery store through hi-rise apartments and condos, office buildings, banks, warehouses, etc.

MASONRY ESTIMATING PROGRAM

The Masonry Estimating Program is geared to the needs of the general contractor, residential contractor and masonry subcontractor. It is capable of take-off and pricing on just about any kind of masonry work. The program handles all types of modular clay brick and concrete block, along with the mortar required for each kind. It is also used for estimating all other masonry items, such as parging, reinforcement, block and cavity fill and wall ties.

RESIDENTIAL CARPENTRY ESTIMATING PROGRAM

This program is designed to take off and price rough carpentry, finish carpentry, millwork, drywall, insulation, siding and roofing for production and custom residential construction. All material and labor costs are extended and summarized simply in a fraction of the time required in the manual method.

JOB COST CONTROL PROGRAM

This cost control program is for general and specialty contractors. It is based on the system generally used by contractors found in Walker's Practical Accounting and Cost Keeping for Contractors.

Information from the daily time sheets (hours worked by each employee, items of work and daily production) is entered in the computer. The estimated quantities and labor are entered and weekly labor cost reports are generated, comparing actual production and unit costs with estimated unit costs. A completion cost is projected for each activity. Material, equipment and subcontractor costs are input and a monthly job cost analysis is prepared.

All of this information is vital to the contractor in controlling his job, and means the difference between success or failure on a job.

PRACTICALC ™ HARDWARE SPECIFICATIONS Minimum 64K computer capacity (128K for IBM-PC) 80 column screen, dual disk drives, 80 column dot matrix printer.

GENERAL FEATURES

1. Low cost purchase price per program
2. Each program has a single purpose
3. The software is developed by estimators
4. Operation requires no computer expertise
5. Each program was tested by contractors
6. The estimator controls all judgement decisions
7. The organization of take-off is dictated by the estimator
8. No chance of extension or computational error
9. The program provides a pricing check list
10. Output is a neatly printed end product
11. No time is spent "number crunching"
12. With this software estimators will be freed for other professional duties.

The PRACTICALC™ programs are designed for simplicity, ease of use, accuracy and low user cost. They will save you considerable time, avoid error and allow you to make maximum use of your computer.

The programs are supported by complete documentation to facilitate training and implementation. The PRACTICALC™ programs will run on a wide variety of microcomputers. Continuing support is provided through telephone service. If you wish, Frank R. Walker will provide assistance in determining which computers are best suited for your job application.

Apple is the registered trademark of Apple Computer, Inc. IBM is the registered trademark of International Business Machines. Kaypro is the registered trademark of Kaypro, Inc.

For specific availability and compatibility of Walker's Practicalc ™ Programs for your computer, contact the Frank R. Walker Company.

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State _____ Zip Code _____

Date _____ Phone ( ) _____

Check One

☐ Check enclosed ☐ MasterCharge

☐ VISA ☐ American Express

Acct. No. _____ Exp. Date _____

Signature _____

Quantity	Program	Specify Computer Brand and Model No. Currently in Use	Single Program Price
_____	Bid Analysis		$595.00
_____	Concrete		$595.00
_____	Masonry		$595.00
_____	Carpentry		$595.00
_____	Home Builders		$795.00
_____	Job Cost		$975.00

Brand and Model of Computer _____

Disk Size and Format _____

Illinois Residents Please add Illinois Sales Tax.

—ALL TRANSACTIONS F[illegible]

Reader Service No. 84

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